A CASE STUDY OF REPAIR/DISCARD IMPLICATIONS IN ILS

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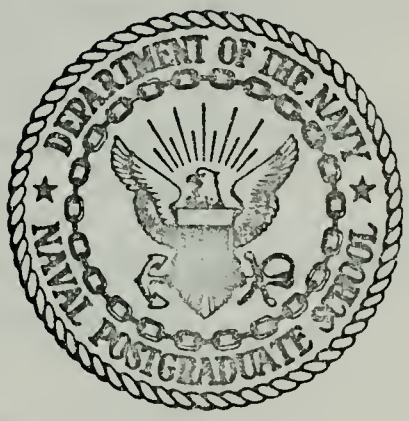

THESIS

A CASE STUDY OF REPAIR/DISCARD IMPLICATIONS IN ILS

by

Edward Bryant Dorsey
and
Malvern Maynard Mizner

September 1974

Thesis Advisor: E. A. Zabrycki

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A case study is developed around the repair/discard decision that impacts heavily on life cycle costs. Background information is provided for students with limited experience in ILS.

APPENDIX B: INSTRUCTOR'S NOTES

The Thesis by E. B . Dorsey and M. M. Mizner has an appendix B which has been printed separately and has availability limitations. While the thesis (without the appendix) is available to anyone, the appendix B is available only to faculty members.(A) Anyone else may contact the Advisor (LCDR. E. A. Zabrycki, Dept. of OR & AS) for further information concerning its availability.

(A) either here or at another educational institution

A Case Study of Repair/Discard Implications in ILS

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

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September 1974

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ABSTRACT

Integrated Logistic Support is a relatively new concept involving many interrelated operations that are critical to the effectiveness of the final product. This thesis is designed to introduce students to the difficulties of implementing ILS in Navy acquisition projects.

A case study is developed around the repair/discard decision that impacts heavily on life cycle costs. Background information is provided for students with limited experience in ILS.

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I. INTRODUCTION

A. PROBLEM STATEMENT

Military readiness is fundamental to national security. In itself, readiness has many connotations depending on the perspective of the individuals participating in the operational arena. Some strategists subscribe to spending the limited defense resources on a few systems that press the state-of-the-art in order to gain strategic advantage. Others feel the limited resources would be better spent on obtaining more equipments that have been proven. What the two have in common is both strategies require the equipment to be supportable.

It has long been obvious that support problems are a limiting factor on the operational capability of any system.[1] Unlike the past, where logistic considerations were made after the item was produced and placed into service, the current concept emphasizes the importance of trading off operational and support requirements at the very beginning of the life cycle. DoD Directive 4100.35G states: "Over the life cycle of a system, support represents a major portion of the total cost, and is sometimes the principal cost item." Integration of logistics considerations into the

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[1]Integrated Logistics Support, Implementation Guide For DoD Systems and Equipment, NAVMAT P-4000, p. II-1.

conceptual planning and through the design process of a weapon system can reduce operational support costs significantly without a degradation of operational availability.[2]

Since ILS is a relatively new concept that represents a substantial departure in both philosophy and implementation from previously used systems, there is a lack of educational material to supplement a course of instruction in ILS. Current directives contain an abundance of information relating to the theory of ILS, however, only minimal historical material is available that addresses the application of this theory into real world situations. Specifically, there is a need for material of the self contained case study type that highlights implementation problems.

B. OBJECTIVE

The objective of this paper was to investigate an ongoing program that implemented the governing ILS instructions and develop a case study around the major problems that have confronted the logistics manager during the initial stages of the life cycle. The case study is designed primarily as an educational aid in presenting ILS to a group of Naval officers in the systems acquisition course of instruction at the Naval Postgraduate School. A secondary objective is to provide a source of historical data.

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[2] *Ibid.*, p. IV-1.

C. METHODOLOGY

A NAVAIR project was chosen for investigation because it was identified as one of the better Navy ILS programs and the company exhibited a willingness to openly discuss implementation problems. Additionally there were several unique features about the particular program which lend application to other acquisitions. These features will be addressed in a later chapter.

The data required to meet the objectives of this paper were obtained through personal interviews of both the contractor and Navy project office personnel. A total of thirty-seven interviews were conducted from the following management positions:

NAVY ORGANIZATION

Previous Project Manager
Current Project Manager
Assistant Project Manager for Logistics (APML)
Assistant Project Manager for Acquisition (APMA)
Naval Plant Representative (NAVPRO)
Resident Integrated Logistic Support Detachment (RILSD)
ILS Evaluation Team Members
Logistic Element Managers:
- Support Equipment
- Maintenance Engineering
- Publications
- Training/Personnel/Trainers
- Material Management

CONTRACTOR ORGANIZATION

Product Support (APM-ILS)
Maintainability Engineering Managers
Maintenance Engineering Analysis Managers
Ground Support Equipment Managers
Publications Managers
Management Information Systems Managers
Logistics Contracts Managers
Technical Data Managers

It was felt that those being interviewed would be more candid in their discussions if the threat of publication was removed, therefore, neither the company nor the project will be identified. The strength of this technique is apparent. The investigator has a better opportunity to obtain information that potentially could embarrass the organization or individuals, however, it is not without its weak points.

The major weakness with this technique lies in the fact that the data collected merely represents the opinions of individual's interviewed. Furthermore, opinions can be quite parochial and biased in viewpoint, particularly if an individual has been intrenched in the job for any length of time.

The case study method of instruction was chosen since it was determined to be the best method for applying practical problems in the relm of ILS management. Part of the learning process is utilizing information in a way which will get participants personally involved in taking responsibility for action in concrete situations of things, people, and events. It provides a method of getting at the strategic point of action from which one may call on any and all relevant science and knowledge to develop solutions to problems which must be overcome to achieve the goals for which an ILS manager must take responsibility.

The learning of ILS management is a unique process unlike the learning in other fields. A search of the ILS literature by the authors has revealed that, in general,

there is no vast body of laws or theories for a student to master which will enable him to prosecute a successful program in ILS. Instead there is a body of principals which can best be conveyed through situational application.

Enlarging one's understanding of subjects in ILS management does not necessarily follow the same process of isolation and control as in the subjects of laboratory science. The process is more of clarifying the strategic elements in specific situations. Perhaps the most important feature of the case method for training ILS managers is that it is situational, for the ILS manager is always dealing with a situation. Each problem is affected by the traditions of the organization in which it arises, the practices of the profession involved, and the relationships among the program officers and contractor personnel. Through presentation of related situations, the case method is an excellent tool for learning about ILS management.

D. SEQUENCE OF PRESENTATION

Chapter I contains introductory material including information on need for the study, its objectives, and scope of the study.

Chapter II deals primarily with the background material relating to the study. It contains a brief history of ILS for students with limited background in logistics and can be easily omitted by those that have had an introduction to project management within the Navy. The latter section of

the chapter contains a brief overview of the ILS areas in which a student should be familiar in order to obtain maximum utility from the case study.

Chapter III discusses significant ILS innovations initiated in the program investigated. The important features of these innovative techniques are described so that future ILS managers might profit from their potential value.

Chapter IV is a synthesis of the opinions of various ILS managers interviewed during the investigation for this study. The authors feel that potential ILS managers may benefit from these lessons learned.

Appendix A contains the case study. It was developed around the repair/discard decision that was a central issue in the avionics support area. The situations described are intended to increase the students awareness of the problems involved in implementing support policies.

Appendix B contains notes to assist the instructor in guiding the discussions toward dealing with the central issues of the case. The appendix has limited distribution but may be obtained from: LCDR E. A. Zabrycki, Code 55Zx, Department of Operations Research and Administrative Sciences, Naval Postgraduate School, Monterey, California 93940.

II. BACKGROUND AND THEORY

A. HISTORY

Historically, logistics has had very little glamour and has been relegated to secondary status utilized only when a specific need or emergency arose.[3] During World War II and for a period of years thereafter, national defense strategic planning was geared to maintaining a good mobilization base. The planning was based on the assumption that adequate time would always be available to bring the nations productive power to full force and that the country would be able to maintain at least an adequate defense until such time as it was accomplished.[4] In this atmosphere, attention was focused primarily on production and delivery of weapon systems. The responsibility for support was often overlooked or given only cursory consideration. Likewise, the total cost of support received little attention.

A weapon system's cost is composed of two primary elements -- acquisition costs and ownership costs. The latter costs are often overlooked, which ignores the significant point that operations and maintenance (O&M) costs, for the most part, far exceed the development and investment costs

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[3] E. J. Shaughnessy, "Development of Integrated Logistic Systems and Equipment," Planning and Research Corporation, November 1964, p. 5.

[4] Samuel P. Huntington, "The Functions of the Military Establishment," The Annal of the American Academy of Political Science, March 1973, p. 3.

(PAMN). The current estimate is about a three to one ratio (3:1).[5]

In an effort to curb these rising costs and to bring them into proper perspective, the Department of Defense introduced the concept of Integrated Logistic Support with the issuance of DoD Directive 4100.35G. Implementing directives were subsequently issued by the Department of the Navy, as indicated in Figure 1. The ILS concept as developed in these directives has essentially three prime purposes:

1. To insure all designated elements of support are identified and provided for early in the hardware development cycle.

2. To insure that the hardware is capable of being maintained by personnel on board and reliable enough to meet operational requirements.

3. To consider possible cost and/or performance tradeoffs early in the development cycle.

Integrated Logistics Support has been aptly called the life cycle management. Implicit in the definition, logistics planning should begin with initial design of the weapon system since this design significantly influences the magnitude and type of support required. Logistic planning that begins after design of the system can ultimately result in higher cost and a degradation of system effectiveness.[6]

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[5] Axtell, G. C., "Designating an Integrated Logistics System," Defense Industry Bulletin, July 1969, p. 23.

[6] Department of Defense Directive 4100.35G, "Integrated Logistics Support Planning Guide," p. 5-7, October 1968.

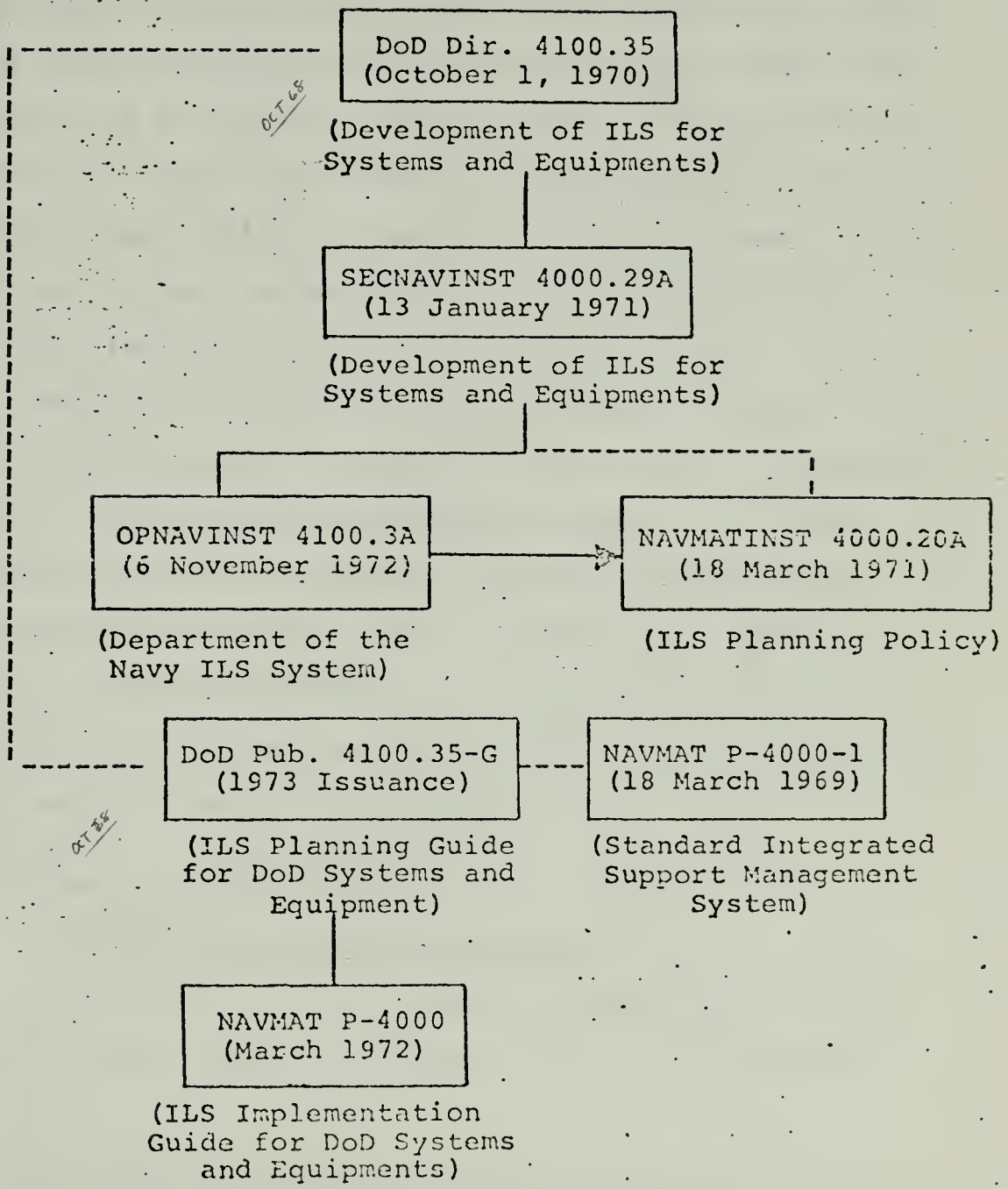
DoD Dir. 4100.35
(October 1, 1970)
(Development of ILS for Systems and Equipments)
SECNAVINST 4000.29A
(13 January 1971)
(Development of ILS for Systems and Equipments)
OPNAVINST 4100.3A
(6 November 1972)
(Department of the Navy ILS System)
NAVMATINST 4000.20A
(18 March 1971)
(ILS Planning Policy)
DoD Pub. 4100.35-G
(1973 Issuance)
(ILS Planning Guide for DoD Systems and Equipment)
NAVMAT P-4000-1
(18 March 1969)
(Standard Integrated Support Management System)
NAVMAT P-4000
(March 1972)
(ILS Implementation Guide for DoD Systems and Equipments)

Figure 1.

Early interface between the design engineer and the logistician is thus recognized as being essential. In the implementing directives, the acquisition manager is made responsible for establishing such relationships and agreements within the Defense Establishment as will enable him to carry out his logistic support tasks.[7] These directives (Figure 1) recognize that the ILS concept requires that all decisions made in the initial design and development shall take into account accompanying logistic considerations.

The relationship depicted in Figure 2 further indicates that it is important for both design and support factors to be taken into account as early in the life cycle as possible. This permits any desired changes to be made prior to entering into actual production, beyond which changes become much more costly. Considering the overall impact on system objectives, it is imperative that the acquisition manager and logisticians have an appreciation for techniques discussed in this paper.[8]

B. PRIMARY ILS CONSIDERATIONS

1. Logistic Requirements Analysis

An important point in the preceeding discussion is that life cycle costs of military systems has now been

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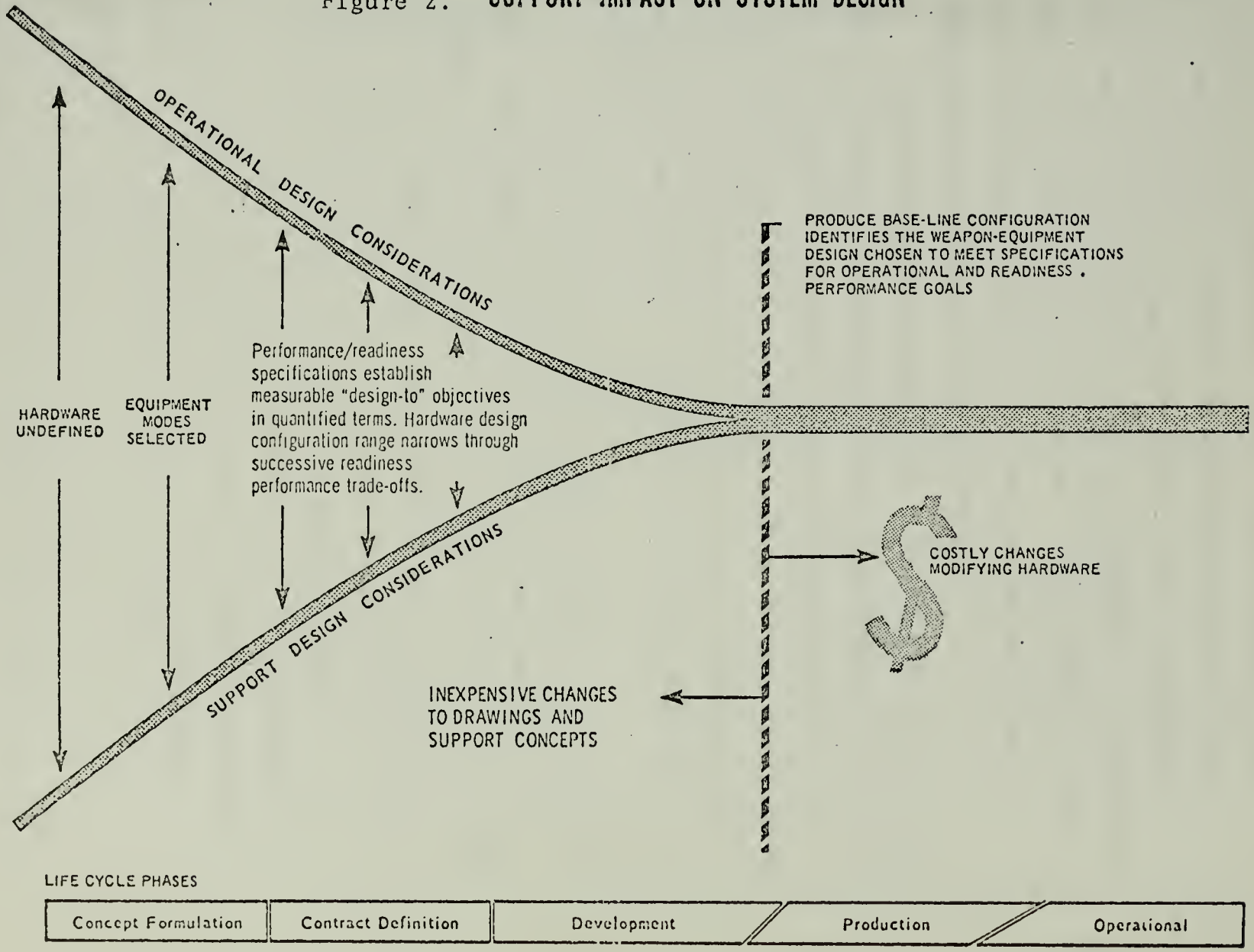
[7] Naval Material Command Instruction 4000.20A, "Integrated Logistic Support Planning Policy," p. 3, 18 March 1971.

[8] *Ibid.*, p. 4.

Figure 2. SUPPORT IMPACT ON SYSTEM DESIGN


OPERATIONAL DESIGN CONSIDERATIONS
HARDWARE UNDEFINED
EQUIPMENT MODES SELECTED
Performance/readiness specifications establish measurable "design-to" objectives in quantified terms. Hardware design configuration range narrows through successive readiness performance trade-offs.
PRODUCE BASE-LINE CONFIGURATION IDENTIFIES THE WEAPON-EQUIPMENT DESIGN CHOSEN TO MEET SPECIFICATIONS FOR OPERATIONAL AND READINESS . PERFORMANCE GOALS
SUPPORT DESIGN CONSIDERATIONS
COSTLY CHANGES MODIFYING HARDWARE
INEXPENSIVE CHANGES TO DRAWINGS AND SUPPORT CONCEPTS
LIFE CYCLE PHASES
Concept Formulation
Contract Definition
Development
Production
Operational

recognized as involving the "total cost incurred by the government from the moment the investigation of its generating idea elicits manpower usage, within or without government, until every piece of the equipment is eliminated from the military logistics system."[9] The function of logistics requirements analysis is now considered to be as important as producability or performance.

The recognition that logistic costs are fixed by the weapon design has resulted in current DoD emphasis on trade-off evaluations for determining and achieving design characteristics of the end item which reduce the logistic support burden. To make ILS work, the tools must be provided for developing the economic consequences for each program decision.

Logistic Requirements Analysis begins early in the life cycle during specification writing and concept formulation. At this point it is less costly to rectify mistakes and adjust design objectives. The trade-off studies are more meaningful since they influence a broader set of specifications at the operational and support levels.

In making support trade-offs, it is imperative the analysis address operational needs that cover specific elements. The DoD Planning Guide 4100.35G defines these elements as:

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[9]Logistics Management Institute, "Life Cycle Costing in Equipment Procurement," p. 2.

a. The Maintenance Plan

b. Support and Test Equipment

c. Supply Support

d. Transportation and Handling

e. Technical Data

f. Facilities

g. Personnel and Training

h. Logistics Support Resource Funds

i. Logistics Support Management Information.

Early stages of Logistic Requirements Analysis is comprised primarily of developing models that will generate the quantitative data necessary in planning for the various elements. A significant step in the analysis occurs when personnel with specialized experience examine the proposed design to determine the supportability impact. Apparent logistic deficiencies identified or recognized at this time are fed back into the design iteration.

The major output from the Logistic Requirements Analysis is a maintenance plan which provides the foundation for coordinated action by both the customer and the contractor's organizations.

2. Organization

The objective on an Integrated Support Plan, as defined in DoD Planning Guide 4100.35G, is to achieve and maintain a specified system effectiveness throughout a weapon systems program life cycle at a minimum of logistics support cost. In order to achieve this end there must be

a management process that centralizes the ILS efforts and assigns responsibilities to the different functional groups in both the government and contractor organizations.

In view of this, the organizational structure is a key element if a successful program is to be pursued. Typically, program managers are chartered by the Systems Commands and have the overall responsibility for the acquisition of the weapon system. It is important that the program manager have a clear understanding of integrated logistic support policies and requirements, however, it must be recognized that his prime concern is to deliver hardware that meets specific performance requirements within a predetermined time and budget constraint.

To insure ILS requirements are effective the program manager appoints an assistant for logistics (APML) who functions as the coordinator for all logistic requirements. The APML may be organically assigned to the project or, in the normal case in the Navy, to the functional logistics chain.[10] As such, he is responsible for the organization, implementation, and management for the ILS program and exercises technical and administrative coordination authority of the element managers. Logistics Element Managers (LEM) may be assigned on either a part or full time basis to a

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[10] Naval Material Command Instruction 4000.20A, *op. cit.*, p. 4.

specific system but physically remain with the parent organization. For example, the LEM for training is organizationally assigned to NAVAIR - 04, (Commander Logistics/ Fleet Support), but may be responsible to a specific APML for a particular weapon system.

The cornerstone for logistics management is vested in the Integrated Logistics Support Management Team (ILSMT). It is chaired by the APML and composed of members throughout the Naval establishment who represent activities responsible for the planning, development, and management of logistic support resources. A typical team from Naval Air Systems Command (NAVAIRSYSCOM) would include personnel from the Aviation Supply Office (ASO), Naval Air Rework Facilities (NARF's), APML, LEM's, and the contractor logistics support organization.

The ILSMT conference provides a forum for the review, modification, and approval of the ILS plan. Functional area subgroups initiate problem documentation through an "action chit" system. Action chits are reviewed by the ILSMT chairman, contractor, and executive committee for resolution. Chits approved for action designate the responsible activity and a deadline for accomplishment. Upon completion of the action the ILS plan will be revised.

From the preceeding discussion it is apparent that integrated logistic support is dependent upon individuals from diverse organizations whose form, location, responsibilities, and *modus operandi* are the product of many factors.

The integration of logistic support then becomes a problem of working across a very complicated matrix through the use of telephone calls, routed correspondence and briefings.

3. Maintenance Engineering Analysis (MEA)

A focal point or integrating force for ILS management and support requirements is maintenance engineering analysis. As evidenced by Figure 3, it is the data source for all functional organizations. MEA consists of an engineering review of system design configuration whose purpose is threefold:

a. to identify the support implications of design,

b. to provide feed-back to the designer by which a more supportable design can be selected,

c. to document the specific support actions required and the resources necessary to effectively carry out those actions.

MEA is an iterative process throughout the life cycle. The maintenance engineering program encompasses a two part analysis effort. Part I concerns design influence and guidance; Part II identifies specific quantitative and qualitative support requirements in response to the data base line. The following is a list of the various MEA exhibits:

(a) Maintenance Plan
(b) Failure Analysis
(c) Maintainability Analysis
(d) Maintenance Requirements
(e) Maintenance Tasks and Personnel Plan
(f) Time Line Analysis
(g) Support Equipment

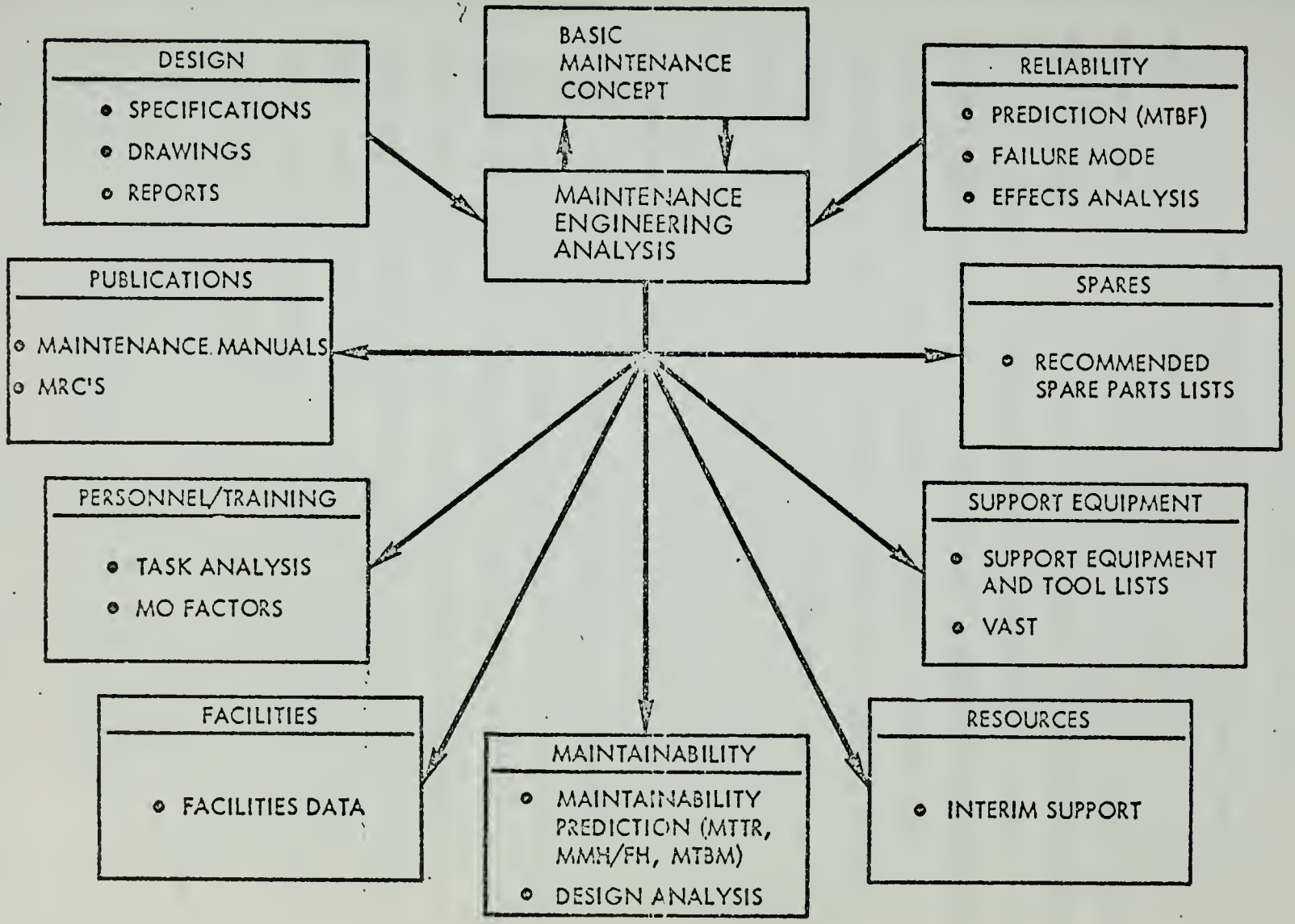
BASIC MAINTENANCE CONCEPT
DESIGN
SPECIFICATIONS
DRAWINGS
REPORTS
RELIABILITY
PREDICTION (MTBF)
FAILURE MODE
EFFECTS ANALYSIS
MAINTENANCE ENGINEERING ANALYSIS
PUBLICATIONS
MAINTENANCE MANUALS
MRC'S
SPARES
RECOMMENDED SPARE PARTS LISTS
PERSONNEL/TRAINING
TASK ANALYSIS
MO FACTORS
SUPPORT EQUIPMENT
SUPPORT EQUIPMENT AND TOOL LISTS
VAST
FACILITIES
FACILITIES DATA
MAINTAINABILITY
MAINTAINABILITY PREDICTION (MTTR, MMH/FH, MTBM)
DESIGN ANALYSIS
RESOURCES
INTERIM SUPPORT

Figure 3.

(h) Parts Breakdown
(i) Support Equipment Requirements.[11]

It is apparent from the above list that the MEA is quite comprehensive and with a slight expansion in some areas, has multiple applications in the acquisition process. As an example, it was pointed out during the investigation for this study that the government pays for the same data several times because of the lack of communication between the functional organizations. ASO buys data for use in provisioning models, Naval Air Technical Services Facility, (NATSF), buys data for use in publications, and management buys data for the information systems. Although not within the scope of this paper, it is conjectured that the MEA is the logical data source for all these requirements.

4. Repair/Discard and Level of Repair Decisions

One of the important design trade-off decisions is whether to design a particular item to be repaired or discarded at failure. This decision impacts upon support resources (technician numbers, skill levels, spares and repair parts, facilities, test and support equipment, and maintenance information), as well as the specific maintenance actions to be taken and at what levels repairs are to be made. The decision also affects such system and equipment design attributes as safety, reliability, accessibility, test points, control, displays, and human factors.

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[11] Naval Air Systems Command AR-30 Addendum 34, "Integrated Logistic Support Program Requirements," p. II-3, 4 February 1972.

Repair/discard decisions are particularly important for avionics systems and equipments. The extensive development of solid state devices and integrated circuits has made possible the high package densities for modular packaging. These techniques have resulted in quantum improvements in reliability and production efficiencies. Consequently discard-at-failure is an economic reality today.[12]

Repair/discard decisions may be classified into two types. The first is design orientated for application in the late planning phases of the system and sorts the items into three distinct categories: those that are clearly discard, those that must be repaired, and those for which the analysis is not definitive.[13] If the item is repairable, diagnostic test points must be designed into the equipment to fault isolate down to the failed component. If an item is to be designed as discard-at-failure, only end-to-end (go/no-go) test points would be necessary. The second type of repair/discard decision is a level of repair decision. It involves the operational phase after the design has been completed. Level of repair is concerned with optimizing the maintenance and support levels at which repairs are most economical to effect. The question to be answered is

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[12] Defense Documentation Center Report AD405779, "Criteria for Discard-at-Failure Maintenance," by E. G. Wrieden, p. 1-3, March 1963.

[13] Kline, Melvin B., "Maintainability Considerations," UCLA Short Course, p. 45-46, June 1973.

whether it is more economical to repair the item at the local level or at a rear support level.[14]

Interaction between repair/discard decisions and other systems design efforts identify five major points in the life cycle where repair/discard decisions might be logically made. The first occurs during concept formulation and systems definition. It depends upon operational, maintenance, and logistic support policies as well as cost-effectiveness and other economic criteria established during concept and system studies. At this level, repair/discard decisions are primarily broad policy decisions which become part of the overall maintenance and logistic concept. They collate into a set of quantitative and qualitative system specification criteria to guide design engineers in the development phases.

The second decision point occurs during engineering development or item selection. The policies and criteria previously established are now applied to assemblies, subassemblies, and modules based upon the analysis of the cost models. The third decision point occurs during late design and early production phases and is concerned with initial source coding and provisioning. At this point the major design decisions have been made, therefore, logistic support decisions such as range and depth of spares, the effect on operational readiness of maintenance and supply delays,

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[14] *Ibid.*

transportation and pipeline effects, numbers and locations of test and repair stations, and similar decisions should be considered.

The forth decision point is a design review that occurs during the operation and support phases of system deployment. Previously established repair/discard decisions are reviewed for validity based upon historical operation and support data collected from field use of the system/equipment. Such a review may result in a change in the repair/discard decision, or at what level to repair, or it may involve a modification of the design. The final decision point analyzes the worth of repairing as a result of damage, age, wear, or other conditions. It answers the question, when is it more economical to throw the item over the side in lieu of transporting it back for repair.[15]

It must be recognized that the quantitative values of most decision criteria are dependent upon a variety of design and support decisions other than repair/discard. These are extremely difficult to aggregate into an economic model. Furthermore, there are other factors that are not quantifiable. A partial list of these are as follows:

- probable gain in equipment reliability through elimination or repair; that is, decrease the adverse effects of technicians accidently injuring equipment;

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[15] *Ibid.*, p. 49.

- probable savings in development cost and manufacturing because of the elimination of the need for accessibility within the throwaway module;
- reduction in unit cost by the manufacture of larger quantities;
- reduction in cost of training, supporting technicians, and facilities;
- release of repair facility floor space for other uses;
- use of facilities for priority repairs rather than indiscriminate queries for many items;
- emotional feelings that discarding complex units is wasteful;
- loss of reliability information when trouble shooting of the component part is eliminated;
- stowage space requirements about half of that required under a repair policy;
- lack of use of current facilities;
- loss of some capability of the forward echelon to react to emergency situations. Spares shortages become more critical unless emergency repair is provided for;
- logistic cost of discard items themselves.

The above listing is an indication of the problems involved in constructing a model. Some logisticians advocate that a decision to repair vice discard (even if slightly arbitrary) allows the most flexibility and the least risk alternative. If an early decision is to discard, then later changes to repair, problems arise. Some of the problem areas include the time lag to acquire repair capability, additional data requirements, additional support equipment requirements, procurement of spare parts, and the government is placed in a "sellers market."

5. Planning and Scheduling

All projects require some form of planning and scheduling. This effort may be done almost unconsciously for small projects, however, major undertakings such as ILS, require the conscious integration and coordination of many functional elements and diverse organizations. The problems of planning and scheduling an effort of this magnitude, particularily in the later stages of development, where changes are being made, can become overpowering.

As described by a group of ILS managers in NAVAIR, the problems associated with ILS plans can be categorized into four basic groupings:

a. Plans are sometimes developed and stated different level than the one required for the execution of the plan. The plans that are developed at a weapon systems level or end item level vary widely with the planning requirements and amount of detail necessary at the subsystem level. When a plan of action is at a different level of detail then the actual execution of the plan, management visibility and control can be seriously hampered.

b. Plans are sometimes oriented toward individual logistic elements, particularly within a matrix organization, and integration of these elements into an overall logistic plan is difficult. The timing and quality of action is difficult to identify in separate plans which may result in the loss of effective management control.

c. ILS plans are difficult to update if the element plans are developed independently. The functional orientation of element plans provides an avenue to keep them updated within themselves but their impact on other elements is difficult to recognize. Additionally, element plans are usually developed by hand and manually maintained. Updating can be quite time consuming.

d. In ILS planning it is difficult to recognize the gradual buildup of in-house repair capability that actually occurs during the acquisition process. For example, an intermediate maintenance activity may have the capability to remove and replace shop replacable assemblies (SRA's) long before it can repair these items. The actual capability is developed incrementally until the maintenance plan is finally realized.

While the above problems may be highlighted in the ILS area, they are common in one form or another, to most planning and scheduling efforts. Network techniques can be used successfully as a tool to minimize these problems. Network techniques establish the interrelationships and interdependencies of all the activities within a program and can provide the manager with an integrating mechanism in which to evaluate their impact on the total program. Furthermore, the use of network planning can be easily mechanized for updating and retrieval of information.

The proper ILS planning and scheduling system provides the logistic manager with a tremendous increase in

capability for the management of an ILS program. The system not only allows early visibility of potential problems, it can also arrange these problems in order of priority according to their impact on program objectives.

III. INNOVATIONS

As the authors reviewed the program there appeared to be several significant innovations initiated in ILS management that have applications in future acquisitions. Three of these are:

1. ILS Test and Evaluation.
2. Floating Support Date.
3. RILSD.

The purpose of this chapter is to describe the important features of these innovative techniques so that future ILS managers might profit from their potential value.

A. INTEGRATED LOGISTIC SUPPORT TEST AND EVALUATION

Historically, testing of weapon systems has primarily been design oriented with a limited emphasis on test and evaluation of ILS. The ILS program for a weapon system/equipment is of significant financial importance and holds sufficient potential impact on the operational availability of the system that a logistics evaluation needs to be conducted on equal priority with the evaluation of hardware and performance characteristics. For various reasons, full advantage has not been taken of this opportunity during past programs.

An ILS evaluation of a weapon system is incrementally accomplished throughout the various phases of Navy Preliminary Evaluation (NPE), on-aircraft Maintenance Engineering

Analysis (MEA), and Board of Inspection and Survey Trials (BIS). This evaluation encompasses the following elements of ILS and verifies the necessity and requirements for follow-on testing during future increments of the ILS evaluation:

- Technical Data
- Personnel and Training
- Spares/Repair Parts
- Facilities
- Transportation/Packaging/Handling
- Ground Support Equipment
- Maintenance Plan.

Organizationally an ILS evaluation team is comprised of technically-oriented personnel from the following Navy activities and operates during designated evaluation times under the direction of the Naval Air Test Center (NATC), with reporting responsibilities to NAVAIRSYSCOM (AIR-410):

NATC Patuxent River, Maryland (Service Test Center)

NAVWPNENGSUPPACT (Naval Weapons Engineering Support Center)

NAILSC (Naval Aviation Integrated Logistic Support Center)

NAVPRO (Naval Plant Representative Office and RILSD)

FIT (Fleet Introduction Team)

NAVAIRSYSCOMREPLANT (Naval Air Systems Command Representative, Atlantic)

NAMTGRU (Naval Air Maintenance Training Group)

NAVAIRREWORKFAC (Naval Air Rework Facility)

ASO (Aviation Supply Office).

The function of the ILS evaluation team is to combine the expertise of the Navy organizations involved into one coordinated group with the common objectives of:

(1) Providing more intensive coverage of ILS during the test and evaluation phases of the weapon system.

(2) Eliminating or reducing overlapping or redundant testing.

(3) Providing early cross training of fleet and development personnel, i.e. Fleet Introduction Team.

(4) Providing a unified Navy position of ILS deficiencies, requirements, and status.

Since the ILS evaluation occurs during the events of NPE and concludes with the BIS Trials, goals are established for each of the evaluation events. All available ILS elements are assessed during each event by describing observed compatibility with that which was planned, the identity of the deficient areas, an assessment of the contractors compliance with AR-30, and the need for follow-on evaluations.

Due to the differences between test/evaluation and operational environments, the ILS evaluation is essentially qualitative in nature rather than quantitative. However, where possible quantitative data is provided to indicate magnitude from which value judgements can be made on the predicted values of mean time between failure (MTBF), reliability, and availability.

The actual effectiveness of the ILS T&E program is not completely known at this writing, however, benefits have

been realized. For example, during the ILS T&E all maintenance tasks are performed by Navy personnel utilizing preliminary manuals. This provides the opportunity to evaluate these manuals for completeness and accuracy in an operational environment prior to fleet introduction.

B. FLOATING SUPPORT DATE

A major milestone in past acquisitions has been the date the Navy assumes responsibility for the entire support of a weapon system. In many cases design instability or major changes have caused the milestone to be breached or has led to inefficient use of scarce resources.

In recognition of the buildup of organic support that naturally occurs in an acquisition process, a new concept of a Floating Support Date was developed that allows for the transition from contractor support to full Navy (organic) support gradually as the design stabilizes. The major concern is to have all the elements fall into place at the right time.

Past experience has indicated that it is simply not feasible to acquire support capability for all three levels of maintenance at the same time unless all capability is delayed until the longest lead capability (usually Depot) is acquired. Such a delay is generally too costly.

Target dates for the Floating Support Date concept is to acquire organizational level maintenance by Fleet Introduction, intermediate level maintenance by the first deployment, and depot level as soon as needed. The acquisition of

depot level will then become the Navy Support Date. In some instances full Navy support will never be realized nor is it necessarily desirable. With some items it is more economical to rely on contractor support than it is to acquire the inhouse capability.

Implicit in the above discussion is the need for a system to track all the items necessary for support on a system by system and level of maintenance basis. It was discovered that there are a variety of different Progress Evaluation or Management Control Systems utilized throughout the government, however, most are tailored to a specific purpose or program. Therefore, the program under investigation developed a Universal Network (UNINET). It is basically a PERT output that reflects a typical ILS program and includes all activities required to accomplish major logistic milestones. The output from the network includes a brief description of the system, a list of the variances, and a critical path analysis with recommendations for the problems. Reports include a Logistics Milestone Summary, Critical Path Report (total float), and an Early Start Report by support element.

The universal net can be easily mechanized enabling the manager to ask "what if" type questions and rapidly determine the impact of various alternative courses of action. In addition, the net forces the contractor to establish the necessary ILS interface requirements in his organization at the very beginning of contract performance.

C. RESIDENT INTEGRATED LOGISTIC SUPPORT DETACHMENT

Perhaps the single most important feature impacting on the success of the program investigated was the establishment of a Resident Integrated Logistic Support Detachment. It is comprised of experienced technicians from Fleet activities who physically reside in the contractor's plant. The RILSD is directly responsible to the ILSMT chairman and is responsive to the ILSMT members of each functional element for matters pertaining to the government technical review and approval of contractor developed ILS requirements. The detachment is administratively responsible to the NAVPRO in all matters concerning the detachment's relations with the contractor. The relationship between the NAVPRO and RILSD is expressed in more detail in the case study, (Appendix A).

The RILSD was established in recognition of the need for on-site representative to provide expertise on Navy in-house maintenance and carrier operations to the contractor. The contractor had previously built aircraft for the Navy but was relatively inexperienced in carrier operations. As the RILSD chairman stated, "The contractor's basic unfamiliarity with carrier/maintenance and real world constraints frequently leads to 'cock-roach' solutions to support requirements."

Composition of the detachment is crucial to its effectiveness. Not only is there a requirement for a top technician but the necessary multiple interface dictates a need for personality orientation. The first thoughts of NAVAIR

was that the detachment should be staffed with engineers to provide the same technical expertise as the contractor and therefore more capable of discussing technical problems. The NAVPRO visualized the detachment's role in a different perspective. Although an engineer himself, he felt the RILSD was not there to solve problems that the contractor was paid to solve. What he expected of the detachment was to define problems that the Fleet would experience in maintaining the aircraft. Through his insistence the detachment composition included a LCDR/1520 (Aeronautical Maintenance Duty Officer) as chairman and four Chief Petty Officers from fleet activities operating similar aircraft from the decks of a carrier.

Obviously all aspects and activities of the RILSD can not be reported on in this study. In the interest of providing a historical base for future programs, just a few of the more salient points are covered.

The first of these is the selection criteria/qualifications of the detachment personnel. The chairman had come up through the ranks, bringing with him fifteen years experience in aircraft maintenance. Additionally, he was a candidate for a Ph.D. in Industrial Engineering. The Chief Petty Officers were selected through a competitive process conducted by the Bureau of Naval Personnel. Out of twelve hundred applicants for the billets, only four were selected. Additionally, the detachment members agreed to accept orders back to fleet activities operating the aircraft and therefore

had a large stake in the supportability of the end item. See Exhibit 12, Appendix A.

The importance of Fleet experience to the designer during the design and development phases is difficult to overstate. The fact that the RILSD team entered the evolution late in this program suboptimized its success. The RILSD was chartered nine months after the contract was signed, however, the permanent staff of Fleet personnel was not identified until one year later or nineteen months into the aircraft design. The "mock-up" reviews had already been conducted with limited Fleet input in which to influence the supportability of design. For example, aircraft on a carrier are normally parked with their tail section over the deck edge in the interest of deck space, yet some pre-flight inspection access panels were placed on the tail section and could not be pre-flighted. Fleet input at this stage could have corrected such errors.

Included in the RILSD charter was approval authority for MEA reviews. In past programs this review was conducted by engineers in AIR-411 and accomplished through correspondence with the contractor. The review consisted of comparing the maintenance plan contained in the MEA with a set of drawings also provided by the contractor/vendor. In contrast, the approach taken by the RILSD was to perform the actual maintenance action on production equipment and compare the results with the plan contained in the MEA. This procedure results in a more realistic support plan as the aircraft moves into fleet introduction.

Another highly successful innovation initiated by the RILSD was in the area of training. The normal procedure is to have training included in the contract as a line item deliverable to the Navy sometime prior to Fleet introduction. Past experience has indicated that there is a considerable time lag from receipt of the actual course materials, devices, etc. and the time the training detachment is prepared to realistically train fleet operating squadrons. The approach taken by RILSD was to augment their team with prospective instructors from NAMTGRU who would participate in the preparation of the training materials to insure they tracked with maintenance requirements. As a result, the maintenance training packages were timely and better reflected Fleet needs.

As a final note on the RILSD concept, the authors could locate no one during the investigation for this study that did not receive some benefit from the detachment, including the contractor. Most were highly enthusiastic about it, in fact, the majority of those interviewed willingly accepted credit for the initiation of the RILSD.

IV. SYNTHESIS

During the process of interviewing various ILS managers for the case study material, some important viewpoints relating to ILS were highlighted. It was felt by the authors that the opinions of these experienced individuals should be synthesized and reported in this chapter so that potential ILS managers might benefit from lessons learned.

Looking back into history it has to be concluded that there has always been logistic support, but what is new in the current emphasis on ILS is the influence of this support on hardware design. Webster defines integration as the process of bringing parts together into a whole. In consonance with this definition, the goal of ILS is to develop a plan which will bring together all the elements necessary for the support of the end item.

The typical ILS plans, at least in NAVAIR, are functionally organized, as are the various ILSMT's which administer the plans. This planning and management by functional logistic elements does not result in integrated support. The ILS Implementing Guide for DoD Systems and Equipment (NAVMAT-4000) recognizes that early planning must be deferred until the configuration of the hardware has been reasonably stabilized, however, if offers no guidance as to how and when to accomplish the detailed planning necessary to achieve integrated logistics support.

The detailed planning required for support of a new weapon system cannot reasonably be done at the weapon system level as currently attempted under existing directives. It appears logical to break the weapon system down into manageable packages and conduct detailed ILS planning by organic support capability on a system by system basis. Organic support capability will only exist when all required elements are available for a particular repair level.

The desired policy for ILS planning should be to attain an in-house support capability prior to the first operational deployment. This is not a capability that can be developed overnight. As one ILS manager put it, "The best way to eat an elephant is a little at a time. Since ILS planning is also a mammoth undertaking, then why not look at acquiring organic support capability a little at a time."

As a logical first step, logistic requirements analysis needs to be conducted at the very beginning in order to identify support requirements. The major deficiencies experienced to date have been the subjectiveness of applied judgement in the analysis. A description of logistics analysis given by one author is "the arithmetic manipulation of applied judgement." If this definition is true and the applied judgement is questionable, then the results of the analysis is also suspect. Currently the questions relative to support are not being answered satisfactorily because the judgement that raised the question is seldom satisfied by the judgement that formed the foundation of the analysis.

As an example, the MTBF is an important parameter of a provisioning decision, yet the number assigned to the MTBF is often just an educated guess by the manufacturer and, therefore, the provisioning decision itself is suspect.

Identification of support requirements is just a beginning. There needs to be a planning/tracking system which will depict interrelationships and interdependencies of the various elements. What is lacking in current directives is a system which indicates logistic requirements by support level on a system by system basis. Without such a system there will never be integration, for there is no tool available to the logistics manager that allows him to intelligently determine what effect changes (proposed or actual) in one logistic element may have on the other.

The MEA approach is an attempt to provide an integrating force for logistics planning. As stated earlier in this study, the main value of the MEA is to provide a common data base for the functional organizations and to force the contractor to utilize an analytical approach to planning and requirements determination. It still does not answer the question of how to plan for the accomplishment of organic support capability.

Perhaps it is time to be more innovative in the planning process. First, admit that there is going to be an interim support period and then plan for the orderly transition to full Navy support. This suggests that ILS planning achieves organic support by degrees. That is, procurement of organizational level support requirements, training, manuals, and

spares would all be based on acquiring these at the same time. Procurement of intermediate level support would be planned so all elements would be available at a support site on the intermediate level support date. The same type of planning would be done for depot level and this would become the Navy Support Date (NSD) for the weapon system.

What is needed to support this logical approach is a set of charts for each level of support with milestones depicted for each of the required elements. The logistics manager will then have the visibility to determine the pacing element and make appropriate decisions to the commencement of work in each element area.

Commensurate with the above discussion, it is important that the dates not be locked in concrete. There must be flexibility to change major ILS milestones based upon technical programs and availability of data. As expressed by one ILS manager, "It is better to be late with quality manuals than on time with inadequate ones."

A basic part of past failures to provide adequate logistic support has its origins in the inability to accurately predict actual failure rates. Decisions are required early in the development cycle concerning whether to plan to discard an item or to repair it. If the decision favors repair, at what level should the repair be accomplished?

From a combined economic/technical analysis there are certain items that clearly fit into discard or repair categories, and decisions for these are easy to make. The

logistics manager is then faced with attempting to choose the least risk alternative for those items for which the analyses leaves the repair/discard decision unclear. If an erroneous decision to discard an item is made and then is later changed to repair, there is a considerable time lag in providing organic repair capability.

The least risk alternative appears to arbitrarily make the repair decision and limit the contractor's work on the item. The merits of an arbitrary repair decision is that if it becomes necessary to change the decision later, it is easier to change from repair to discard than from discard to repair. It allows flexibility in finalizing repair/discard decisions. An early decision to repair would permit procurement of all repair/provisioning data during the competitive time frame and avoid placing the government in a "seller's market" later in the aircraft's life cycle.

An obstacle to the integration of logistics support is the unwillingness or inability of people to go outside their respective spheres of authority/responsibility to surmount the rigid adherence to functional structure and get involved in what other individual's are planning or doing. Integration cannot be achieved at the top of the pyramid. It must take place at the working level.

Navy projects basically depend upon existing organizations and activities for logistics support. The ILS manager is therefore forced to manage across functional blocks within his parent organization and across organizational lines with

respect to outside organizations. Those functional elements are also supporting other activities of their parent organization. When personnel are not available to support all these demands, the ILS manager finds less responsiveness than desired from the functional elements. His situation is made even more difficult because the functional elements were there long before his program started and will be there long after his program ends.

Another aspect of this problem is the tendency of the functional specialists to see their discipline as the central core of a successful program. Their commitment to their functional specialty leads them to attempt to dictate what will be done as distinguished from advising what should be done. One of the most difficult concepts to put across to functional specialists is that the ILS manager is responsible for determining what will be done. The functional specialist is responsible for how it is done, the how being his area of expertise.

As presently practiced, it is conjectured that a program manager has a built-in conflict that must be resolved if maximum utility is to be achieved in major programs. He has as a prime objective, to support the needs of the Fleet. This implies that the major emphasis must be concentrated in providing equipment with the performance necessary to meet a threat and the equipment must be available within a specific time frame. Furthermore, congressional scrutiny of the defense budget has been less severe in the operational

and maintenance (O&M) area than in procurement (PAMN). Clearly the individual program manager's evaluations, and hence, the driving force, is performance and schedule, not support. There is no way to achieve optimum support for a weapon system unless supportability is given priority equal to performance.

APPENDIX A: THE SRA REPAIR/DISCARD CASE

Commander Jim Kirk, the Assistant Program Manager for Logistics (APML) on the A-13 Wildcat Project, was deeply concerned that a definite support plan for the avionics shop replaceable assemblies (SRA) had not yet been established. Jim was chairing an A-13 maintenance plan review conference which had commenced on March 3, 1972 and had been in session for two days. The SRA support plan had been one of Jim's major concerns since his appointment to the position of APML in January 1971. To complicate matters, over eighty percent of the SRA's were being designed by the contractor without diagnostic test points and would be difficult to repair with presently planned test equipment. The Navy Support Date had to be met by late 1974, so Commander Kirk's purpose in scheduling this conference was to evaluate his alternatives and develop a definite SRA support plan. Jim was also under pressure from the program manager, Captain Regal, who was awaiting his decision.

BACKGROUND OF A-13 PROJECT

The A-13 Wildcat was an all-weather, carrier based attack aircraft being designed and produced by Defense Aircraft Corporation (DAC) for the Navy under a fixed price incentive contract. The contract was awarded to DAC in January 1970 after close competition among several bidders. When the A-13 was going through its early stages of concept

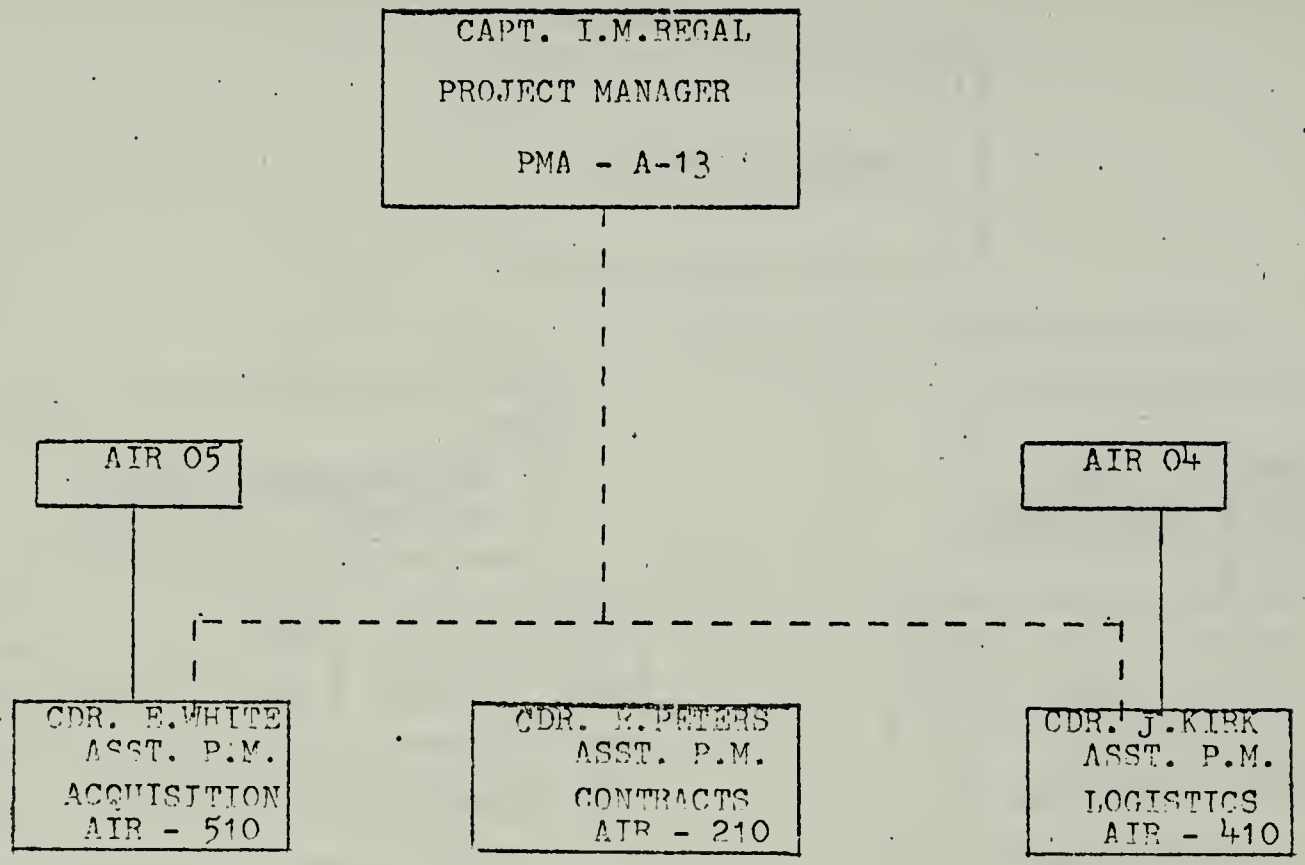
formulation and contract definition the concept of Integrated Logistics Support was given a great deal of emphasis by the Department of Defense. The RFP reflected this emphasis by requiring the contractor to submit an ILS management plan as part of the proposal. This plan was the contractor's proposed effort to achieve and insure maintainability design and logistic subsystem integration to the degree required to meet the stated operational use and support of the entire weapon system.

During the source selection process the contractor's proposed ILS plans were thoroughly evaluated by an ILS evaluation team which consisted of a group of individuals from NAVAIR, ASO, Navy Laboratories, and other support activities.

Navy A-13 ILS Organization

The A-13 APML was given equal status to the other functional assistants to the program manager. This relationship is shown in Exhibit 1. The APML was directly responsible to the A-13 program manager for the organization, implementation, and management of the A-13 ILS program. He was also responsible to his functional superior in the Logistic/Fleet Support branch in NAVAIR since he was functionally assigned to that organization. The APML was assisted by element managers who were also assigned to their respective functional divisions. (See Exhibit 2.)

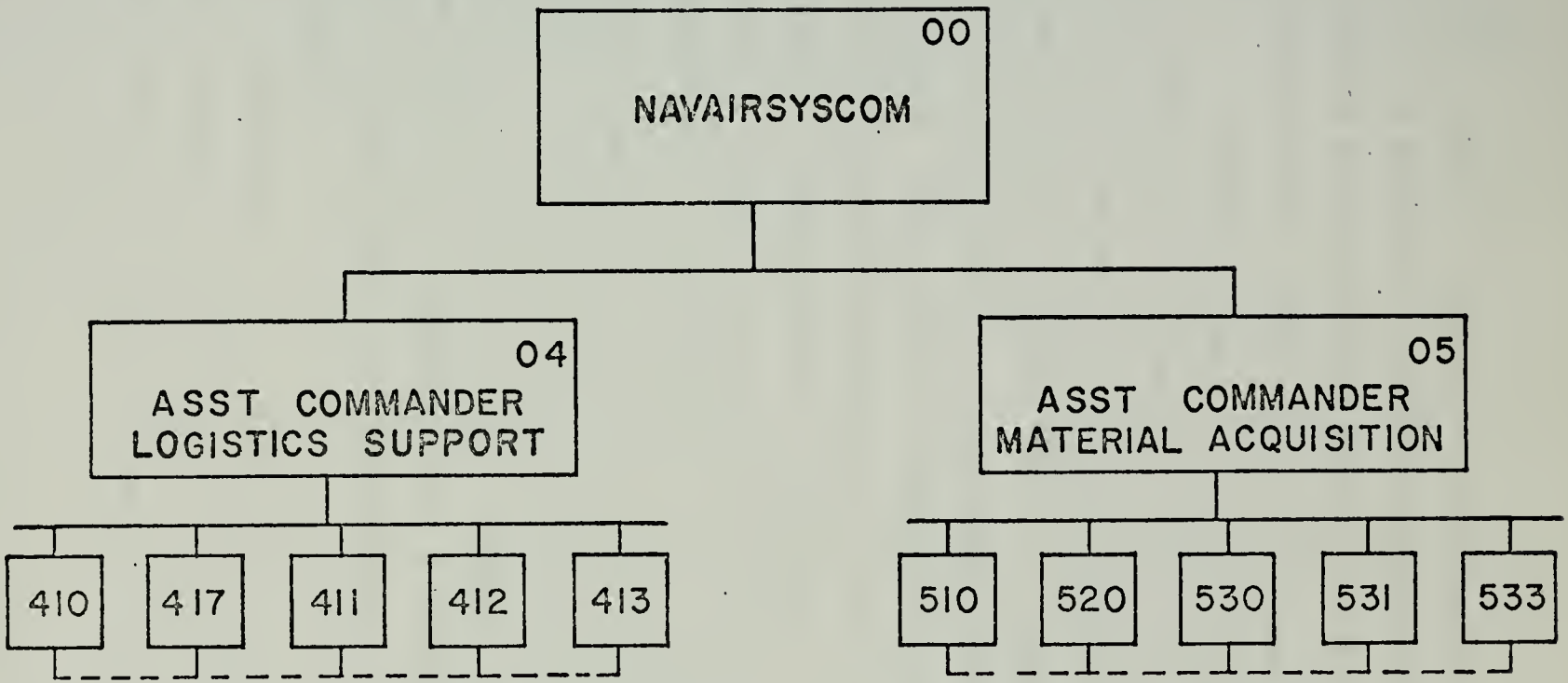
A significant amount of interface was required between the APML and the assistant program manager for acquisition



NAVY A-13 P.M. FUNCTIONAL ASSISTANTS

Exhibit 1.

Exhibit 2.



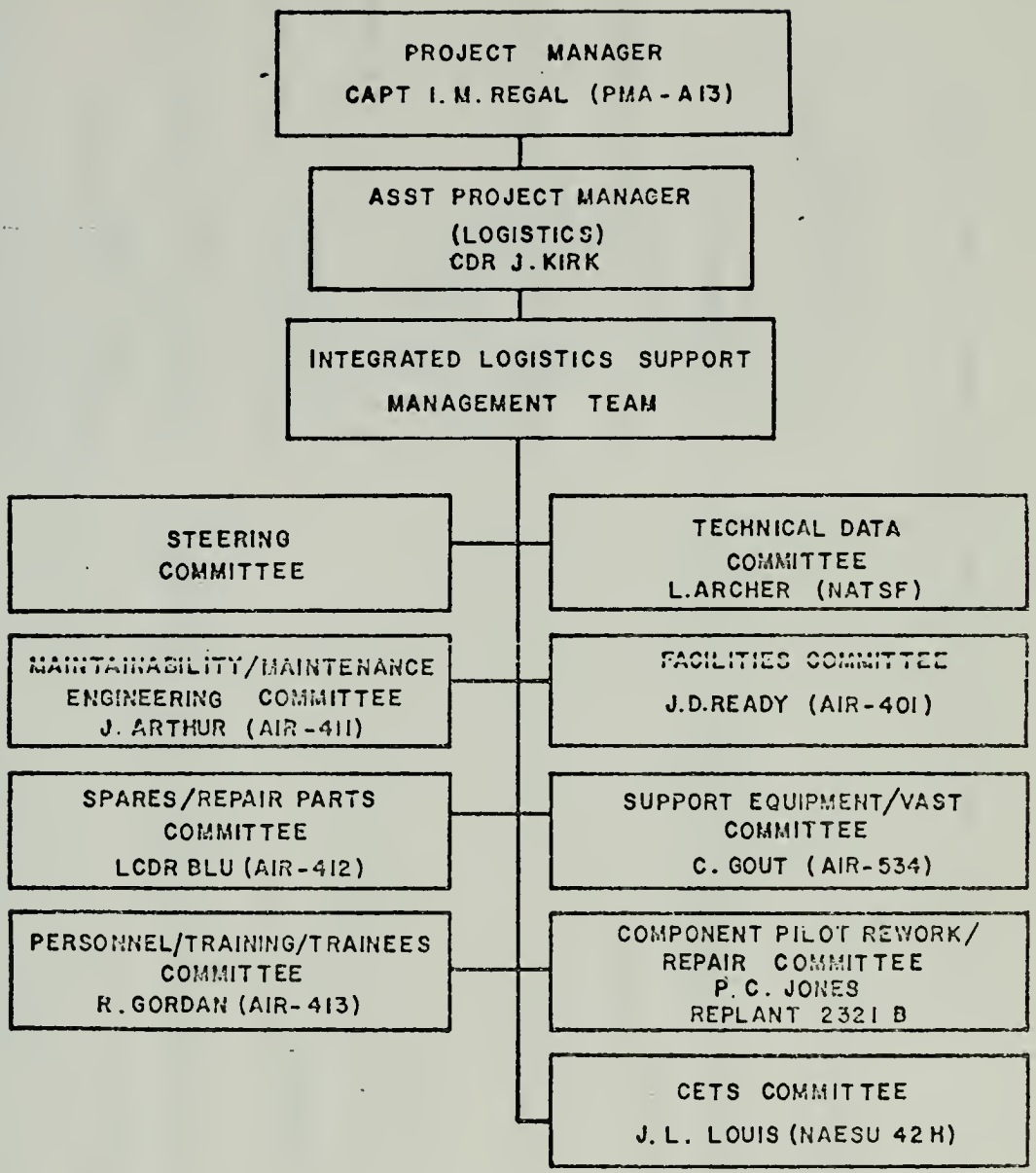
NAV AIR FUNCTIONAL DIVISIONS

(APMA) and their functional assistants in NAVAIR. Although both the Material Acquisition and Fleet Support/Logistics branches were physically located in the Washington, D. C. area, they were separated by a distance of several miles.

An Integrated Logistics Support Management Team (ILSMT) was established to provide a forum for coordinating support activities and requirements between the NAVAIRSYSCOM and associated Navy commands with A-13 support responsibilities, and with the contractor. The APML served as chairman of the ILSMT. The ILSMT was responsible to him for effective monitoring and implementation of the ILS plan. All of the logistics element managers were members of the team in addition to other representatives which the APML considered appropriate. (See Exhibit 3.) The contractor also had a similar team with a counterpart for each Navy member. The complete ILSMT consisting of both Navy and contractor members met at periodic intervals, usually every six months. (See Exhibit 4.) Exhibits 5 and 6 depict the ILSMT role and a typical meeting which was usually separated into subcommittees.

A NAVPRO was on-site at the contractor's plant which was located on the West Coast. The NAVPRO administered the A-13 contract in addition to another major aircraft contract already in progress.

After a few months into the design phase, Pete Masson, the first APML, had felt that an on-site ILS team in addition to the NAVPRO was necessary to fully implement ILS in



NAVY ILSMT ORGANIZATION

Exhibit 3.

GOVERNMENT MEMBERS	CONTRACTOR MEMBERS
1. Assistant Program Manager (Logistics) CDR J. Kirk (Air-410)	Director, A-13 Product Support Joe Harris
2. Logistics Contracts Joe Clark (Air-214)	Logistics Contracts Jack Adams
3. Maintainability/Maintenance Engineering Committee J. Arthur (Air-411)	Maintainability/Maint. Eng. Committee Bill House
4. Spares/Repair Parts Committee LCDR Blu (ASUWLWHA)	Spares/Repair Parts Committee D. Reeder
5. Personnel/Training/Trainers Committee R. Gordon (Air-413) F. Swift	Personnel/Training/Trainers Committee F. King Ed Tilly G. Heard
6. Technical Data Committee L. Archer	Technical Data Committee H. Franklin
7. Support Equipment Committee C. Gout (Air-534)	Support Equipment Committee K. Saint
8. Contractor Engineering Technical Services Committee J. Louis (NAESU)	CETS Committee L. Bender
9. Facilities Committee J. D. Ready (Air-401)	Facilities Committee D. Stanfield

Exhibit 4. Integrated Logistics Support Management Team (ILSMT).

ILS FUNCTIONAL FLOW

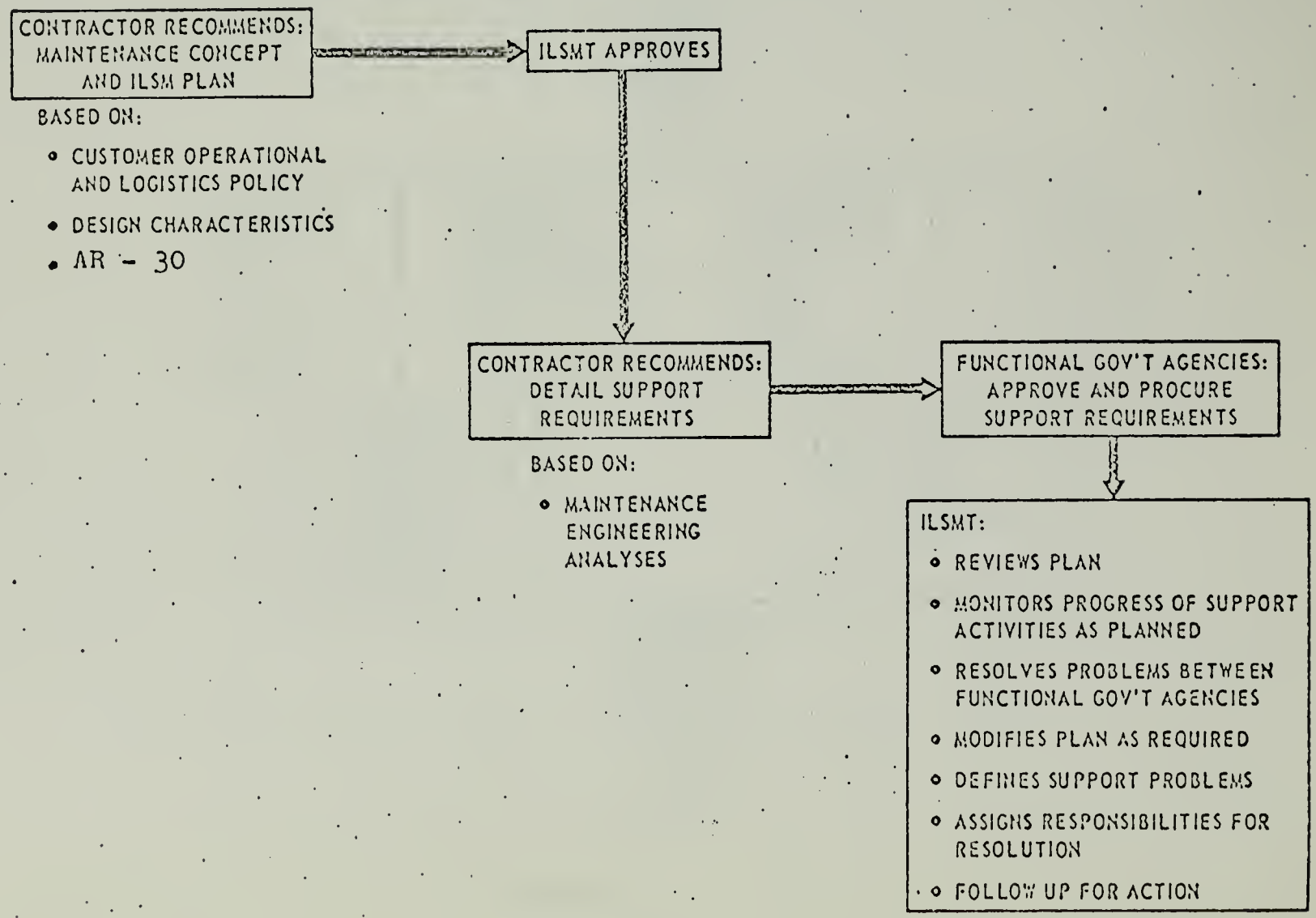

CONTRACTOR RECOMMENDS: MAINTENANCE CONCEPT AND ILSM PLAN
BASED ON:
• CUSTOMER OPERATIONAL AND LOGISTICS POLICY
• DESIGN CHARACTERISTICS
• AR - 30
ILSMT APPROVES
CONTRACTOR RECOMMENDS: DETAIL SUPPORT REQUIREMENTS
BASED ON:
• MAINTENANCE ENGINEERING ANALYSES
FUNCTIONAL GOV'T AGENCIES: APPROVE AND PROCURE SUPPORT REQUIREMENTS
ILSMT:
• REVIEWS PLAN
• MONITORS PROGRESS OF SUPPORT ACTIVITIES AS PLANNED
• RESOLVES PROBLEMS BETWEEN FUNCTIONAL GOV'T AGENCIES
• MODIFIES PLAN AS REQUIRED
• DEFINES SUPPORT PROBLEMS
• ASSIGNS RESPONSIBILITIES FOR RESOLUTION
• FOLLOW UP FOR ACTION

Exhibit 5.

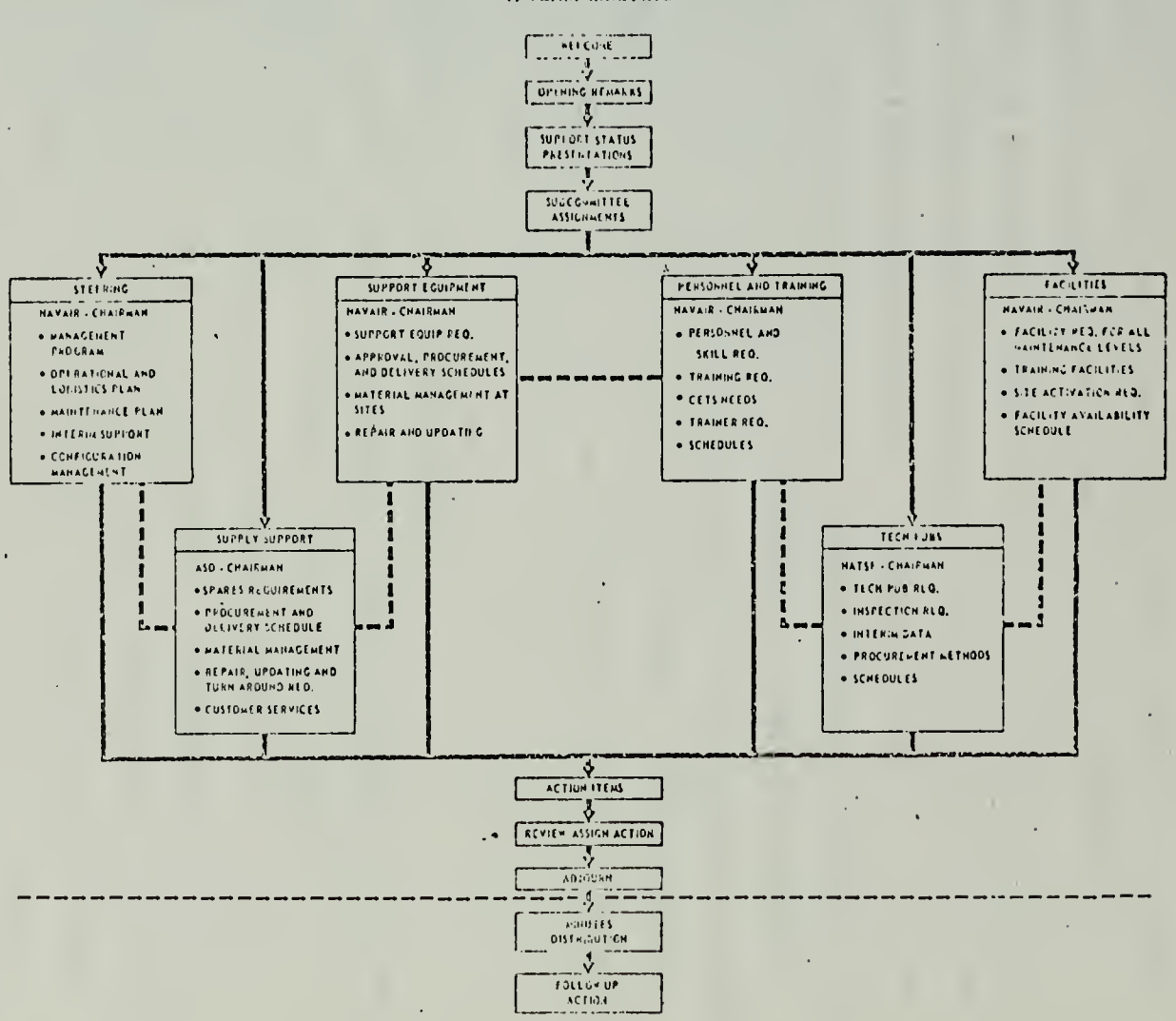

A TEAM MEETING
WELCOME
OPENING REMARKS
SUPPORT STATUS PRESENTATIONS
SUBCOMMITTEE ASSIGNMENTS
STEERING
NAVAIR - CHAIRMAN
• MANAGEMENT PROGRAM
• OPERATIONAL AND LOGISTICS PLAN
• MAINTENANCE PLAN
• INTERIM SUPPORT
• CONFIGURATION MANAGEMENT
SUPPORT EQUIPMENT
NAVAIR - CHAIRMAN
• SUPPORT EQUIP REQ.
• APPROVAL, PROCUREMENT, AND DELIVERY SCHEDULES
• MATERIAL MANAGEMENT AT SITES
• REPAIR AND UPDATING
PERSONNEL AND TRAINING
NAVAIR - CHAIRMAN
• PERSONNEL AND SKILL REQ.
• TRAINING REQ.
• CETS NEEDS
• TRAINER REQ.
• SCHEDULES
FACILITIES
NAVAIR - CHAIRMAN
• FACILITY REQ. FOR ALL MAINTENANCE LEVELS
• TRAINING FACILITIES
• SITE ACTIVATION REQ.
• FACILITY AVAILABILITY SCHEDULE
SUPPLY SUPPORT
ASO - CHAIRMAN
• SPARES REQUIREMENTS
• PROCUREMENT AND DELIVERY SCHEDULE
• MATERIAL MANAGEMENT
• REPAIR, UPDATING AND TURN AROUND REQ.
• CUSTOMER SERVICES
TECH PUBS
NATSF - CHAIRMAN
• TECH PUB RLQ.
• INSPECTION RLQ.
• INTERIM DATA
• PROCUREMENT METHODS
• SCHEDULES
ACTION ITEMS
REVIEW ASSIGN ACTION
ADJOURN
MINUTES DISTRIBUTION
FOLLOW UP ACTION

Exhibit 6.

the A-13. Through Pete's persistence and with the backing and support of the NAVPRO head, Captain Green, a Resident Integrated Logistics Support Detachment (RILSD) was established in June 1970. The objective of the RILSD was to provide a permanent team of highly qualified fleet personnel with "wrench turning" experience who would have day-to-day contact with the contractor. Initial assignment of personnel to the RILSD consisted of the chairman, Lieutenant Jim Smith, from NAVPRO who was assisted by temporary members from various support commands and activities until permanent membership could be assigned from BUPERS. The management relationships, functions, and responsibilities of the RILSD are outlined in Exhibit 7.

Contractor A-13 ILS Organization

Defense Aircraft Corporation had responded to the Navy's emphasis on ILS by elevating the A-13 ILS manager to the position of A-13 Assistant Program Manager-ILS (APM-ILS). The contractor's ILS organization is depicted in Exhibit 8. The APM-ILS was established as the counterpart to the APML on the Navy side of the program. He was the focal point for A-13 contracts relating to ILS, and had the responsibility for planning, directing and controlling company-wide efforts to develop and implement A-13 ILS plans.

The APM-ILS served a dual role similar to the Navy APML in that he reported to the contractor A-13 program manager and also to his functional superior, the director for Product Support. He was assisted by the functional divisions

Exhibit 7.

MANAGEMENT RELATIONSHIPS, FUNCTIONS AND RESPONSIBILITIES

RELATING TO THE

RESIDENT INTEGRATED LOGISTICS SUPPORT DETACHMENT

1. Management Relationships. The following relationships are established:

a. With the NAVPRO:

(1) The RILSD will be administratively attached to the NAVPRO for all matters relating to contract performance and progress, government/contractor liaison, and technical surveillance of the contractor's support program development effort. As such, the RILSD will operate with the local administrative procedures established for the NAVPRO. The RILSD will report concurrently to the NAVPRO and to the Chairman, ILSMT.

(2) Any communication prepared by the RILSD involving issuance of direction, authorization, or contract interpretation to the contractor will be issued only by the appropriate signature authority within the NAVPRO organization.

(3) The NAVPRO will keep the RILSD advised on all technically related contractual matters which affect logistic support.

b. With NAVAIR:

(1) The RILSD shall be under the technical direction of the Chairman, ILSMT for matters directly affecting the A-13 logistics support program. However, RILSD members shall also be responsive to their parent commands for those logistic program procedures and functions for which the parent commands have cognizance.

c. With the Contractor:

(1) RILSD personnel are authorized direct liaison with appropriate contractor personnel to provide technical guidance in the specific logistic support element areas such as Navy in-house maintenance capabilities, support personnel requirements, provisioning procedures and requirements, technical documentation and support equipment requirements. However, this authorization shall not be interpreted as authority to change or alter contractual requirements or commitments. Recommendations or requirements for such actions shall be transmitted to or through the NAVPRO for appropriate action.

Exhibit 7. Continued

2. Functions and Responsibilities. The RILSD shall:

a. Assure that MEA procedures are employed effectively in the development of a comrephensive and economical logistic support system for the A-13 weapon system. This responsibility shall include the review of support requirements and data developed for and by the MEA process, the necessary coordination of the data, and the technical approval of such data for acceptance by the Government. MEA data to be reviewed, coordinated, and approved for Government acceptance includes:

(1) Maintainability and reliability program data inputs to the MEA process relating to or affecting support requirements.

(2) Level of repair decisions.

(3) Organizational, intermediate, and depot level maintenance requirements and tasks including performance time.

(4) System, subsystem, and component maintenance plans.

(5) Ground support equipment requirements for all maintenance levels.

(6) Input data for technical manuals.

(7) Personnel requirements data and personnel planning summary.

(8) Maintenance training requirements.

(9) Repair parts requirements.

(10) Provisioning documentation requirements including source, maintenance, and recoverability coding.

b. Review and approve the Support Material Lists and ensure that the required material is ordered through the NAVPRO.

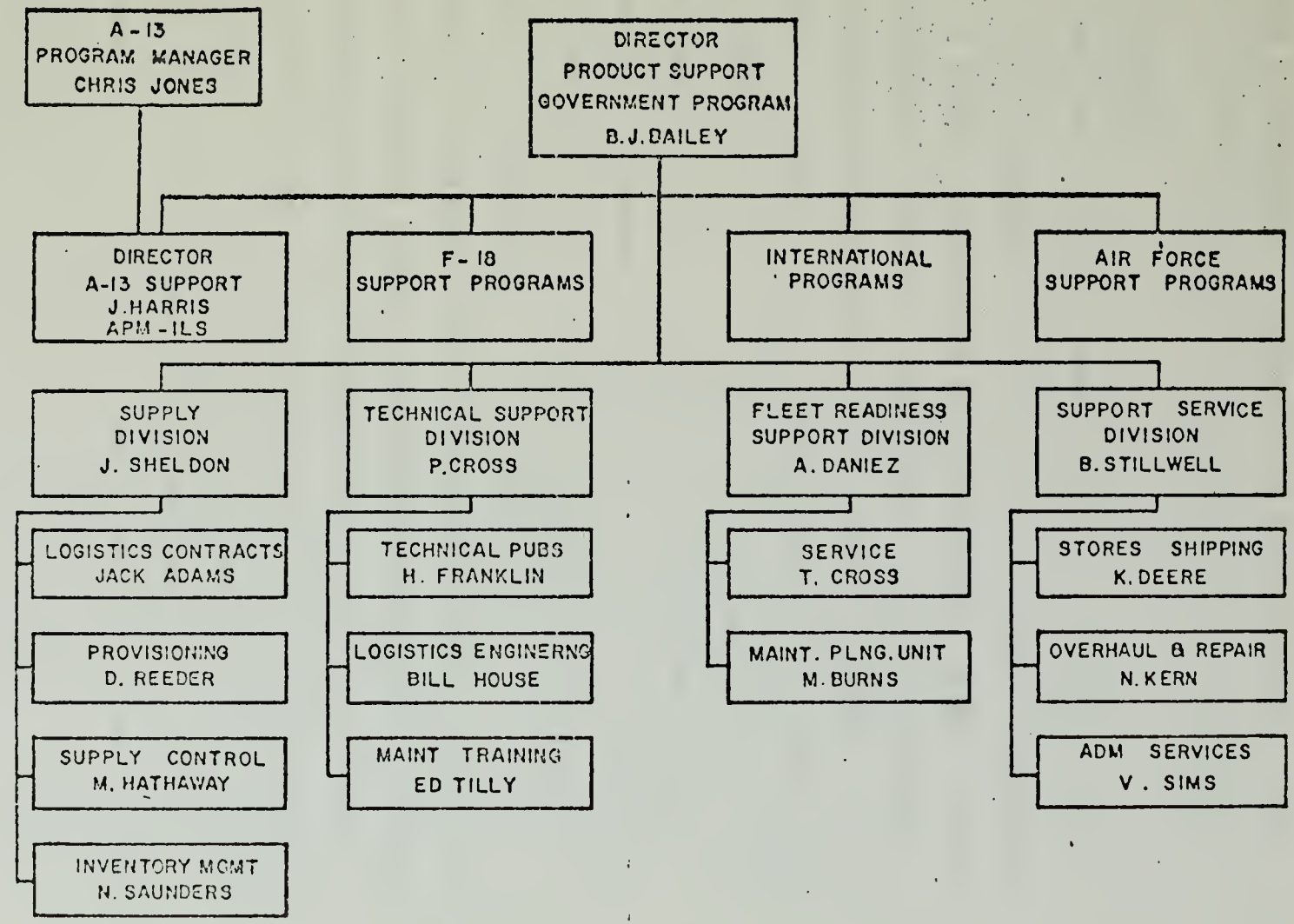
c. Monitor Government furnished equipment requirements for support of the A-13 program.

d. Monitor the Component Pilot Rework/Repair Program and assuring timely delivery of CPR/R changes to the requiring activities.

Exhibit 7. Continued

e. Report known or anticipated deficiencies in logistics support requirements to the Chairman, ILSMT and maintain continuing surveillance until such deficiencies are resolved.

Exhibit 8.



DAC. ILS. ORGANIZATION

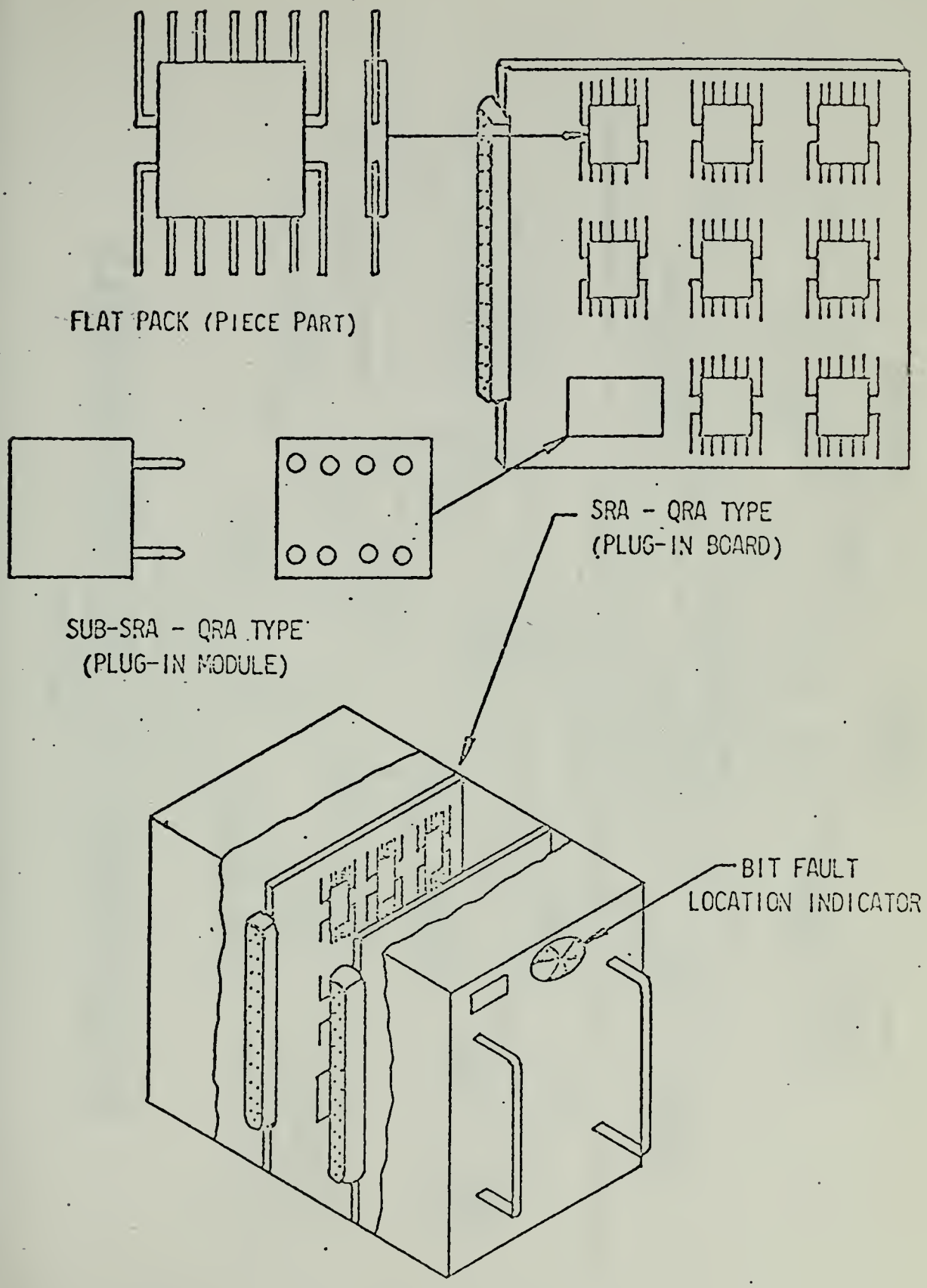
depicted in Exhibit 8. Appropriate managers in the divisions acted as counterparts to the Navy members on the ILSMT.

SRA BACKGROUND

A shop replaceable assembly (SRA) is an avionics package or module contained within a larger avionics component called a weapon replaceable assembly (WRA). A WRA is composed entirely of SRA's. (See Exhibit 9.) The avionics maintenance concept for the A-13 is that the avionics components be designed so that a faulty WRA can be quickly and easily replaced on the aircraft at the organizational level of maintenance. The faulty WRA can then be sent to the intermediate maintenance activity (IMA) where the malfunctioning SRA can be detected and replaced with the use of automatic test equipment. (See Exhibit 10.)

The A-13 contract included the specification that the avionics equipment would be designed in accordance with the guidelines set forth in aeronautical requirements AR-10A, General Requirements for Maintainability of Avionics Equipment and Systems. This specification outlined the maintainability and built-in test (BIT) requirements for avionics equipment. It also specified the guidelines by which avionics circuits were to be modularized to provide SRA's and WRA's. The applicable portion of AR-10A which referred to modular design read as follows:

> "Circuits shall be packaged into discrete replaceable modules of such cost and reliability that disposal-on-failure rather than module repair is the most cost effective logistic support action. Performance, operability, design complexity, reliability, system life,

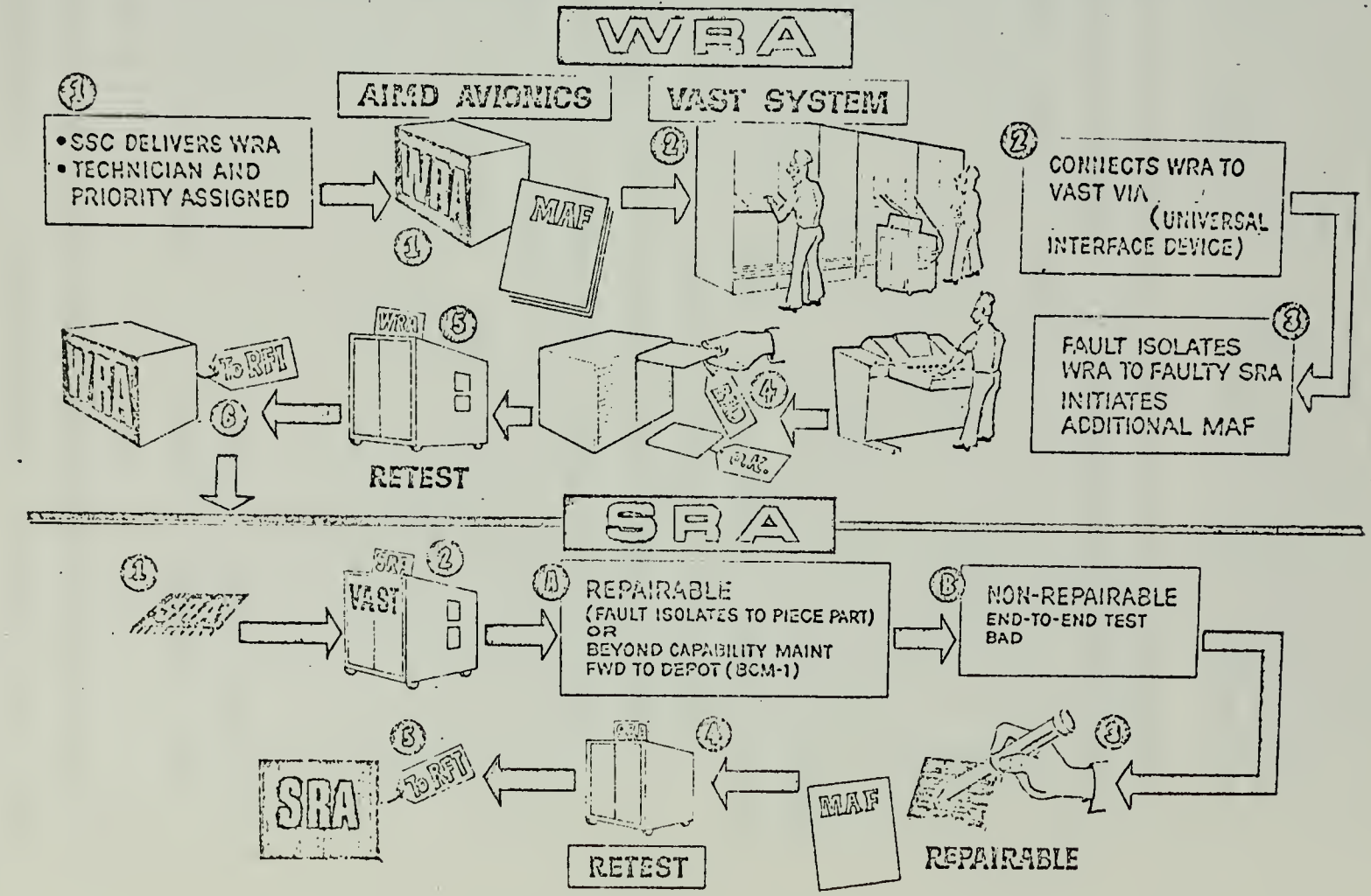


TYPICAL WEAPONS REPLACEABLE ASSEMBLY (WRA)

Exhibit 9.

Exhibit 10.

INTERMEDIATE MAINTENANCE ACTIVITY



functional use, supply support, equipment cost, fault isolation, repair cost, and equipment availability are typical trade-off factors to be considered whether a module shall have several or many microelectronic circuits, discrete component parts, etc. Any module costing 500 dollars or less, having a reliability of 50,000 hours or greater MTBF shall be designed for disposal-on-failure. Other modules require procuring activity approval if the module is to be designed as non-repairable."

Since the A-13 avionics system was to be composed of approximately 1300 SRA's, it was extremely important that the criteria used to categorize an SRA as repairable or discard-on-failure was clear and well understood by the prime contractor and his suppliers. Also of major importance was the fact that SRA's designed to be repairable would require diagnostic test points built into the design. These diagnostic test points were required to make the SRA compatible with VAST (Versatile Avionics Shop Tester). VAST is a sophisticated automatic test station capable of testing avionics equipment from several aircraft types. VAST stations are installed at IMA's aboard aircraft carriers and shore stations. SRA's designed as discard-on-failure also required compatibility with VAST, but only end-to-end (go/no-go) test points were necessary. The reason for requiring end-to-end test capability on discard-on-failure SRA's was to provide a means of verifying whether or not the unit is bad so as to prevent discarding SRA's with no fault.

Two months after the contract was awarded, Defense Aircraft Corporation submitted a proposal to amend AR-10A for

specific application to the A-13 avionics system. DAC had been anxious to obtain NAVAIR approval of the proposed application so they could provide their subcontractors with guidance in designing SRA's. The following amendment to AR-10A was approved and incorporated into the detailed specifications:

> "Circuits shall be packaged into discrete replaceable modules of such cost and reliability that disposal-on-failure rather than module repair is the most cost effective logistic support action. Performance, operability, design complexity, reliability, system life, functional use, supply support, equipment cost, fault isolation, repair costs, and equipment availability are typical trade-off factors to be considered when determining whether a module shall have several or many microelectronic circuits, discrete component parts, etc. All modules from equipments requiring VAST compatibility whether repairable or non-repairable will be designed to permit an end-to-end test using VAST. Figure A-1 shall be utilized to determine whether VAST compatible equipment modules (SRA's and sub-SRA's) shall be designed to permit fault isolation to the component level using VAST. Modules falling on or to the left of the 1 cent per MTBF-HR line will be designed for end-to-end testing only. Modules falling on the 3 cents per MTBF-HR line or to the right of that line shall be designed for VAST testing to the component level. Modules costing in excess of one (1) cent and less than three (3) cents per MTBF-HR will be analyzed in depth to determine if design shall include testing to the component level by VAST. A design for repair to component level is indicated when life cycle cost of repair is 90 percent, or less, of throwaway life cycle cost. The following formulae shall be used in the computation of life cycle cost analysis:
>
> Life Cycle Failures
>
> $$\frac{N_M \times N_A \times N_B \times L_C}{MTBF} = \text{Life Cycle Failures}$$
>
> N_M = Number identical modules per aircraft
>
> N_A = Number operational aircraft (144)
>
> N_B = Number operating hours per month (150)

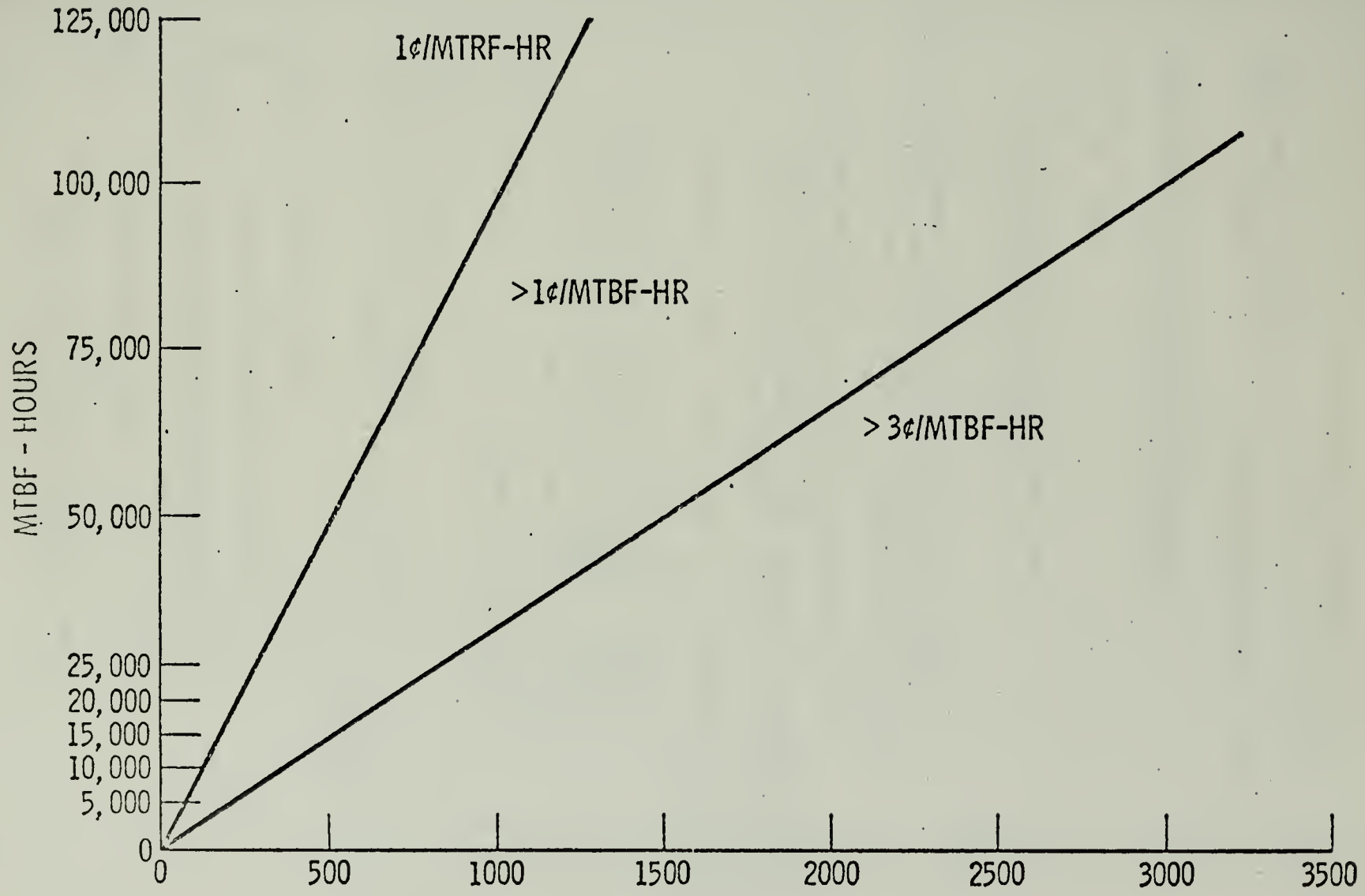


Figure A-1. MTBF–COST CHART

L_C = Life cycle in months (120)

$$\frac{N_M \times 144 \times 150 \times 120}{MTBF} = \text{Life cycle failures} = N_F$$

Life Cycle Cost Estimate Per Module*

$C_T = C_P + C_{MP} + C_S$

C_P = VAST software programming cost
$14,000 Throwaway Basis
$35,000 Repair Basis

C_{MP} = Manpower cost of technician at $9/Hour
$13.50 each failure - throwaway basis x N_F
$27.00 each failure - repair basis x N_F

C_S = Spare/Repair parts cost + cost per line Item in allowance list/IPB
$50.00 repair parts, each failure - repair basis
$1000.00 per line item at $100 per year for 10 years

Estimated number line items for repairable modules:

6 line items, module cost less than $200
10 line items, module cost $200 - $499
15 line items, module cost $500 - $899
20 line items, module cost $900 - $1399
25 line items, module cost $1400 - $2000

*Cost of Design for Test Points not Included.

Life Cycle Throwaway Cost

$[\$13.50 \times N_F + \$15,000 + (N_F \times M_C)]1.3$ = Life Cycle Throwaway Cost

$13.50 = Manpower Cost

N_F = Number Life Cycle Failures

$15,000 = VAST Software Programming Cost ($14,000 + 1 Line Item ($1,000))

M_C = Module Cost, Each

1.3 = Operation and Maintenance Costs (Navy Developed per RFP)

Life Cycle Repair Cost

$[\$77 \times N_F + \$35{,}000 + (L \times \$1000) + (0.1\,N \times M)]1.3$

= Life Cycle Repair Cost

$77 Manpower Cost = ($27) + Spare/Repair Cost ($50)

N_F = Number Life Cycle Failures

$35,000 = VAST Software Programming Cost

L = Number Line Items (Module + Repair Parts)

0.1N = Spare Modules (10% Total Failures)

M_C = Module Cost, Each

1.3 = Operation and Maintenance Costs.

Mean-Time-Between Failure (MTBF) shall be established for electronic modules utilizing the reliability stress and failure rate data specified in MIL-HDBK-217A and the Rome Air Development Center (RADC) workbook Volume II. (Quality adjustment factors for lower grade parts shall be used where applicable.) For components not covered in above references, MTBF's may also be established on the basis of failure rates suitably substantiated by test and field data and as modified for the intended operational environments and usage time period. Module MTBF's reflecting the above data shall be indicated on the cost worksheets submitted in accordance with provisions herein. When handbooks other than the above two are used to compute MTBF's, a source data worksheet summary shall be provided along with the cost worksheet.

Cost of modules will be those cost of spare equipments procured under Lot V of the A-13 contract.

It is desired that to the maximum practical extent modules designed for throwaway as defined above be designed so that, if repair of the module, at some point in time, becomes economically viable, the equipment may be repaired using test equipment, not necessarily VAST. When a conformal coating is used it shall be a type which is easy to remove and reapply. In any event, not more than 2 percent of the total SRA's (modules) shall be made unrepairable (i.e., potted in such a manner as to preclude repair).

A life cycle cost worksheet (see Figure A-2) shall be prepared for all applicable modules, and a copy will be forwarded to the procuring activity.

MODULE _____ QTY _____ EQUIPMENT _____

MODULE COST $ _____ MTBF _____ LIFE CYCLE FAILURES _____

- THROWAWAY BASIS

  MODULE COST $ _____ x _____ FAILURES = TOTAL MODULE COST $ _____

  C_P = $14,000

  C_{MP} = _____ ($13.50 x _____ FAILURES)

  C_S = $1000 ($100 x 10 YEARS)

  C_T = _____

  TOTAL MODULE COST $ _____ + C_T $ _____ = $ _____ (SUBTOTAL)

  SUBTOTAL $ _____ x 1.3 0 & M COSTS = $ _____ LIFE CYCLE THROWAWAY COST $

- REPAIR BASIS

  SPARE MODULES @ 10% LIFE CYCLE FAILURES _____

  SPARES _____ x $ _____ (COST PER MODULE = $ _____ SPARE MODULE COST

  C_P = $35,000

  C_{MP} = $ _____ ($27 x _____ FAILURES)

  C_S = $ _____ ($50 x _____ FAILURES = $____ + ____ LINE ITEMS x $1000 = _____

  C_T = $ _____

  SPARE MODULE COST $ _____ + C_T $ _____ = $ _____ (SUBTOTAL)

  SUBTOTAL $ _____ x 1.3 0 & M COST = $ _____ LIFE CYCLE REPAIR COSTS

  REPAIR COST IS _____ % OF THROWAWAY COST

  RECOMMEND: THROWAWAY ☐ REPAIR ☐

Figure A-2. LIFE CYCLE COST WORKSHEET

Deviation to the above criteria will be subject to NAVAIR approval."

Pete Masson, the First A-13 APML, had recognized the criticality of a throwaway decision because once the SRA was designed for throwaway, it could not be repaired using VAST since the fault could not be detected without the automatic test points. For this reason the AR-10A amendment included the stipulation that to the maximum possible extent, SRA's designed for throwaway be designed so that, if repair of the module at some point in time became economically viable, the equipment could be repaired using some type of test equipment, not necessarily VAST.

A few months after Commander Kirk assumed the role of A-13 APML he began to show concern about the increasing number of "throwaway recommended" SRA life cycle cost worksheets which were being forwarded to NAVAIR in accordance with AR-10A. Jim felt that the contractor was designing too many SRA's for throwaway. He displayed his feelings one day while talking with one of his logistics element managers by saying, "I just can't believe that it's economical or practical to throwaway eighty percent of our SRA's when they fail. If we develop a support plan based on this philosophy, the aircraft carrier will have to tow a barge behind it to carry the spares. The vendors can make a mint on repairing the throwaways and selling them back to us."

Commander Kirk felt that the SRA issue needed more exposure. He wanted to make sure that the A-13 avionics

system was supportable when the aircraft entered the fleet. As an experienced fleet aviator and aircraft maintenance manager, he did not want to see some of his support problems with previous aircraft repeated with the A-13. He planned to emphasize the issue at the next ILSMT conference.

APRIL ILSMT CONFERENCE

On April 3, 1971 an ILSMT conference was held at the contractor's plant. Two major items on the agenda were the SRA's and the A-13 mock-up reviews. The A-13 had been in the design stage for over a year and mock-up reviews were already in process. These mock-up reviews were the first hardware form to be evaluated for maintainability. The purpose of a mock-up review is to evaluate the qualitative features of the design such as accessibility, simplicity, work environment, resource requirements, man-machine interface, and arrangement and location of the components.

As the conference proceded on the SRA issue it became evident that there was no consensus among the Navy and contractor personnel as to which direction to proceed in establishing a support plan. While discussing the matter with Joe Harris, the contractor APM-ILS, Commander Kirk presented the view that AR-10A should never have been interpreted as a level-of-repair analysis as it appeared the contractor had done. The real objective of AR-10A was to guide the design of the SRA's so that excess weight and size could be held to a minimum by not designing diagnostic test points into SRA's which were clearly uneconomical to repair. Commander Kirk

strongly commented that he had very little confidence in the MTBF's that some of the suppliers were predicting of their SRA's. On some of the high cost SRA's the predicted MTBF's were high enough to drive the cost to less than one cent per MTBF-HR, causing them to be placed in the throw-away category.

Joe Harris defended the methods by which the SRA's had been classified by reminding Jim that the Navy had given full approval to the methodology which was used. Joe pointed out that it was beneficial for the Navy to accept a throwaway decision even if they considered the data to support a definite decision to be lacking. He reasoned that a throwaway decision would avoid the cost of setting in motion the establishment of repair capabilities, such as test equipment, maintenance manuals, etc. He further emphasized the fact that SRA's were composed of micro-miniaturized circuits of high component density which are difficult, if not impossible to repair, especially at the intermediate level of maintenance.

To counter Joe's point in the nonrepairability aspects of micro-miniaturization, Jim Kirk noted a report that a micro-miniaturized circuit repair kit had recently been introduced on the market and might have possibilities for minor local repair at the intermediate level. He further remarked that SRA's which had no diagnostic test points could possibly be repaired by manually probing.

In an effort to obtain more information on the issue, Jim requested comments and recommendations from the ILSMT members. He was specifically interested in the impact that a decision to repair the SRA's locally would have on the A-13 support plan. The major impact areas discussed were:

(1) There would be a time lag to acquire full repair capability. In other words, local avionics repair would have to be achieved first at the WRA level and later at the SRA level.

(2) Additional data requirements in the areas of training, repair, and provisioning would be generated.

(3) Additional automatic test equipment would be required.

(4) Procurement of many additional repair parts (bits and pieces) would be required.

It was clear to Commander Kirk that the finalized SRA support plan should not be an arbitrary decision. An apportunity to obtain additional information on which to base a decision was provided by the maintainability committee which recommended that a level-of-repair analysis using AR-60 (Level-of-Repair for Aeronautical Material) be performed on the SRA's. AR-60 had recently been issued by NAVAIR and the committee felt that the results of an analysis using the AR-60 model would produce a higher level of confidence than AR-10A was providing on repair/discard decisions. Commander Kirk agreed and made plans to obtain funding for the study from the program manager.

In the meantine some guidance was necessary for the contractor in preparing Maintenance Engineering Analysis (MEA) exhibits for the throwaway designed SRA's. The ILSMT conference adjourned with Commander Kirk emphasizing that the SRA's could not be considered "consumable" until such time that a final decision could be made as to whether an SRA should, in fact, be discarded at failure. NAVAIRSYSCOM subsequently issued a letter to all concerned parties delineating the Navy policy on SRA's. (See Exhibit 11.)

Upon Commander Kirk's return to Washington after the ILSMT conference, he briefed the program manager on the topics discussed and summarized the status of the A-13 ILS program. Captain Regal agreed to fund the level-of-repair analysis using the AR-60 model which the ILSMT recommended and subsequently notified the contractor to submit a proposal describing the methodology to be used in conducting the analysis. It was understood that the results of the analysis were to be used only for consideration by the program manager and APML to assist them in making a decision on a definitive SRA plan since AR-10A was still the contractual document driving the design of the SRA's.

In June 1971, DAC submitted their proposal and was funded $160,000 to conduct the analysis.

RILSD BUILDUP

As of June 1971 the RILSD was still comprised of temporary members, but it was apparent that permanent membership was necessary if the team was to be an effective unit.

AIR-411E/201:LEP
May 10, 1971

From: Commander, Naval Air Systems Command
To: Distribution List

Subj: Disposition of A-13 Avionic SRA's (Shop Replaceable Assemblies) Designed for Disposal-on-Failure; policy concerning

Ref: (a) NAVPRO Westville 0813072 Feb 1971
(b) AR-10A as amended for A-13
(c) AR-60

1. Reference (a) requested NAVAIR's guidance for DAC in preparing MEA (Maintenance Engineering Analysis) exhibits for those SRA's which are being designed to meet the disposal-on-failure criteria contained in reference (b).

2. Background: Reference (b) directs that circuits shall be packaged into discrete replaceable modules of such cost and reliability that disposal-on-failure rather than module repair is the most cost effective logistic support action. Reference (b) also expressed the desire that to the maximum practical extent modules designed for throw-away be designed so that, if repair of the module at some point in time becomes economically viable, the equipment may be repaired using test equipment, not necessarily VAST. The intent of reference (b) was to provide a screening technique which would provide the basis for determining which VAST compatible SRA's should be designed for VAST testing to the component level and which should be designed only for VAST end-to-end testing.

3. Discussion: Since the criterion of reference (b) includes SRA's with high unit cost, the question has been raised of whether the government can, in fact, consider these high cost SRA's "consumable" until operational data can verify the validity of predicted cost/reliability rates. An analysis in accordance with reference (c) will hopefully commence in the near future and should produce higher confidence discard/repair and level of repair decisions. In the meantime, as discussed at the third ILSMT Conference held April 1971, interim provisions must be made to retain these failed "consumable" SRA's at a suitable stocking point for such time as is necessary to validate the discard/repair decision.

Exhibit 11.

Exhibit 11. Continued

4. Action:

a. DAC will recommend on the applicable MEA exhibits the Uniform Source, Maintenance and Recoverability code which will insure that no repair is authorized on the disposal-on-failure SRA's and the lowest maintenance level authorized to condemn them is the depot level. Repair data and parts breakdown will not be required from the SRA vendor but would be obtained at a later date for those SRA's which are subsequently coded repairable. Reversals in the maintenance concept on these items could well involve more cost than was originally envisioned, and therefore, must be held to a bare minimum. DAC will closely scrutinize and audit their vendor's life cycle cost analysis and other design factors which are the basis for the repair decision to insure that the disposal-on-failure decision is based on sound and valid criteria. Life cycle cost worksheets required by reference (b) will be submitted with DAC's recommendation and attendent rationale and justification for the repair/dispose decision. All presently available life cycle cost worksheets shall be submitted to the Naval Weapons Engineering Support Activity and the RILSD upon receipt of these instructions. Subsequent submittals of the life cycle cost worksheets shall be on a monthly basis until all of the subject worksheets have been delivered to the Navy.

b. NAVAIR will establish by separate action procedures for the handling, storage and inventory control of the failed subject SRA's at some suitable stocking point.

c. NAVAIR will establish procedures for the collection and analysis of cost/failure data and make the final decision whether to retain the dispose-on-failure code or to establish repair capability by obtaining repair data, peculiar ground support equipment and appropriate training.

/s/
By Direction

The persistent efforts of the NAVPRO head, Captain Green, resulted in the initial selection of four chief petty officers and one lieutenant commander. (See Exhibit 12.) The chairman, Lieutenant Commander Herb Barker had an impressive background in aircraft maintenance. He had been an aircraft maintenance officer in fleet activities for ten years and was a candidate for a Ph.D. in Industrial Engineering. All four chiefs had carrier aircraft operations experience and were familiar with typical fleet maintenance and support problems.

The RILSD office was located in the same building with DAC Project Support personnel, causing some of the contractor personnel to have reservations about this close involvement by the government. As detailed in its charter, one of the primary purposes of the RILSD was to assure that Maintenance Engineering Analysis procedures were employed effectively by the contractor. Inspection and teardown of hardware in conjunction with MEA reviews was considered necessary by Herb Barker for the MEA's to be of any real value. He was very disappointed to discover that this teardown and inspection had neither been planned for nor funded by the project office. Herb was of the opinion that the RILSD would be ineffective unless his chiefs had as much access to the aircraft and major components as possible, therefore, one of his first accomplishments was to convince the APML and program manager to permit his team to visit the major subcontractors (vendors) and actually observe a

B/AOC/deh
Ser: 1206
16 March 1971

From: Naval Plant Representative Westville
To: Chief of Naval Operations (OP-100)
Via: (1) Naval Air Systems Command Representative, Pacific
(2) Naval Air Systems Command, Washington, D. C.

Subj: Additional Staffing for A-13 Program; request for

1. The RILSD was established under charter from the Naval Air Systems Command in June 1970. At this time the RILSD is still without a permanent staff. Implicit in the RILSD function of day-to-day direction of the contractor is the requirement for continuity of that direction. This in turn demands at least a semblence of "permanance", which cannot be attained with temporary members.

2. The majority of the members of the ILSMT have agreed to the need for a permanent RILSD staff. The only objection voiced was by NAVAIR personnel from the AIR-411 organization who expressed reservations about local determinations (by RILSD) on maintenance matters with the attendent by-passing of "cognizant desks" in NAVAIRSYSCOM(AIR-04). This reservation appears to be in direct conflict with the basic concept of RILSD; i.e., the establishment of policy by NAVAIR through the ILSMT and the delegation of authority and responsibility for its execution to the on-site RILSD. It is believed that the RILSD, or something similar, is mandatory if the A-13 ILS program is to be successful. Augmentation of the military staffing of the NAVPRO for approximately three years with fleet experienced personnel would be a most effective means to implement it. In addition, the collateral benefit to the Navy of having a pretrained cadre of personnel to move with the weapon system into operational squadrons would obviously be of tremendous value. If compensating billets within the Shore Establishment cannot be located, possibly Fleet activities could provide compensation, in view of the downstream pay-off of a weapon system designed to account for the pragmatics of "real-world" operations and maintenance plus Navy personnel knowledgeable in depth to insure a smooth and effective transition into Fleet service.

3. It is requested that the following augmented military staffing be approved and implemented at NAVPRO Westville:

Exhibit 12.

a.	One LCDR/LT 1520	-	Head, A-13 RILSD
b.	One ATC	-	Member, A-13 RILSD
c.	One AEC	-	Member, A-13 RILSD
d.	One AMC	-	Member, A-13 RILSD
e.	One ADJC	-	Member, A-13, RILSD

4. It should be obvious that the men selected should be chosen with care. These men should be the best in their rating groups in technical skill and experience, in ability to express their thoughts clearly, and an ability to work with people of other career patterns. It is further considered highly desirable that wherever possible turnover of representatives be held to a minimum.

5. When the tour of duty of the personnel is complete, they should receive orders back to the Fleet where their expertise in the A-13 would prove useful. The billet with the RILSD should expire with the detachment of the incumbent, as the MEA-writing period would have been completed. As these personnel detach, the RILSD itself would also be dismantled, having completed its mission.

/s/
S. E. Green

Exhibit 12. Continued.

teardown of each component. The APML, Jim Kirk, considered the proposed visits valuable for two reasons. First, a design review of the components would be beneficial in conducting MEA reviews, and second, the visits would provide the opportunity for experienced Navy practitioners to have a close look at the SRA's and make some judgement as to their repairability at the intermediate maintenance level.

The Navy's intent to conduct the Vendor visits was formally announced in a letter to the prime contractor citing as justification the A-13 aircraft specification which provided for design reviews to be conducted periodically during contract performance. (See Exhibit 13.)

AR-60 STUDY COMPLETED

In February 1972 the AR-60 Level-of-Repair study was completed and forwarded to the A-13 project office by DAC. The result of the analysis revealed that approximately forty percent of the SRA's would be more economical to repair than discard. Comparing this to the AR-10A recommendations resulted in 290 additional SRA's being recommended as repairable. However, in evaluating the results of the study, Commander Kirk and Lieutenant Commander Barker were dismayed to discover that some incorrect assumptions were made in generating inputs to the computational model. For example, the support equipment costs were based on the assumption that all of the WRA's were composed of SRA's with diagnostic test points. It was difficult to determine to what extent these suspect inputs had on the results, therefore, it was

AIR-400/99:MEL
28 January 1972

From: Commander, Naval Air Systems Command
To: Defense Aircraft Corporation
Via: Naval Plant Representative Office, Westville

Subj: Contract P00021-70-B-0538; A-13 Weapon System Design Reviews

Ref: (a) AS-6714

Encl: (1) Vendor Visit Schedules

1. Paragraph 3.2.8 of reference (a) states that formal design reviews shall be conducted periodically during the course of the A-13 contract.

2. A formal design review by cognizant Navy and DAC personnel is appropriate at this point in time in order to:

a. Evaluate maintainability of the system/sub-system/equipments.

b. Verify the maintenance plan.

c. Review recommended ground support equipment requirements.

d. Select appropriate Component Pilot Rework/Repair candidates.

e. Observe progress toward design stability.

f. Review provisioning documentation requirements.

3. In order to expedite completion of the desired design reviews, NAVAIR proposes to establish four teams for review of the following areas:

a. Avionics Systems

b. Electrical/Instruments/AFCS/Miscellaneous Systems

c. Engine/Fuel/APU/Accessories

d. Airframe/Hydraulic Systems

Exhibit 13.

Exhibit 13. Continued.

Each team which will be chaired by a representative of the A-13 RILSD, will consist of cognizant DAC personnel, Fleet personnel and representatives of other Navy commands.

4. The Contractor is requested to schedule design reviews in accordance with enclosure (1). Each vendor must be prepared to provide the following:

a. Functional description in sufficient depth to allow meaningful discussion of the vendor recommended maintenance plan for organizational, intermediate and depot levels.

b. Review of vendor test/support equipment and recommended GSE.

c. Inspection of hardware on the production line in sufficient depth to permit correlation to Navy maintenance skills and capabilities.

d. Recommended assembly/disassembly/rigging procedures.

e. Fault isolation/functional test procedures.

f. Calibration/adjustment requirements and procedures.

g. Technical manuals/data requirements (including identification of proprietary data).

h. Spares and repair parts recommendation including production lead times.

i. Recommendations concerning CPR/R packages.

j. Review of reliability data including study methods and test results.

The proposed schedule may be modified as mutually agreed by the Contractor and the Chairman, A-13 RILSD.

I. M. Regal,
CAPTAIN, United States Navy
Project Manager, A-13

decided that any decision based on the AR-60 study would be deferred until after the vendor visits were conducted. Jim expressed his frustration with the situation by saying, "If the Navy would have done more level-of-repair analyses prior to awarding the contract, we wouldn't have this problem of trying to make the right repair/discard decision. I think it would have been better to design the SRA's to be repairable, because it's a lot easier to change from repairable to throwaway than from throwaway to repairable."

VENDOR VISITS

The tour of the major subcontractors began in May 1972. Four teams were formed to conduct the visits. Each team was headed by a chief petty officer from RILSD and included contractor maintainability/supportability personnel and representatives from the fleet and various Navy support activities.

During the tour, the teams discovered the subcontractors were very receptive to fleet interests and were generally delighted to discuss their product with them. The engineers were quite surprised to learn of the many constraints that exist when operating from a Navy carrier at sea. At the conclusion of the tour, Herb Barker had mixed feelings. He was now convinced that the permanent RILSD should have been established earlier in the A-13 life cycle to have any meaningful influence on the design. Once the components are in production changes are difficult and expensive to make. Although untimely from the design perspective, the visits did

prove valuable to the RILSD from the standpoint of providing data relative to the support requirements of the aircraft.

MAINTENANCE PLAN REVIEW CONFERENCE

Two weeks after the subcontractor visits were completed, Commander Kirk scheduled a special A-13 maintenance plan review conference at the contractors plant. Key individuals associated with the SRA issue, including the deputy project manager, were in attendance. His objective was to consolidate all SRA data accumulated to date to assist him in making a definitive SRA support plan decision. Time was running out and he had to decide soon.

During the course of the meeting, all factors which might contribute to the SRA support plan decision were discussed. Reports from the teams which conducted the vendor visits indicated that from a non-economical point of view it was feasible to repair up to eighty percent of the SRA's at the carrier intermediate maintenance activity if adequate automatic test equipment was available. This was not a unanimous opinion, however. The view of some of the team members was that attempts to repair many of the SRA's locally would result in further damage and reduced reliability due to the close density of the components.

A few months earlier Commander Kirk had received additional information relating to WRA and SRA repair which compounded the problem. Preliminary studies revealed that the planned three station VAST complex aboard aircraft carriers would not have adequate capacity to handle the WRA/SRA

workload from all the on-board aircraft. Several other type aircraft contained VAST supportable avionics systems and this time limitation on VAST suggested that local repair capability might be seriously affected unless supplemental automatic test equipment was made available. In fact, the contractor was already conducting a Navy funded study to determine the extent of extra test equipment requirements. This study included a look at the diagnostic requirements for SRA's that had been designed without diagnostic test points for possible inclusion into the design of supplemental automatic test equipment.

It was apparent that a decision to locally repair SRA's which had been designed with only end-to-end test points would require a substantial investment in additional automatic test equipment. Commander Kirk still felt, however, that a support philosophy driven by AR-10A would result in eventual depletion of ready assets and excessive stockpiling of units in a non-ready-for-issue (non RFI) status due to the inability of intermediate maintenance activities to repair.

During the maintenance plan review meeting, Herb Barker presented an analytical technique he had developed by combining some of the criteria of both AR-10A and AR-60 which he felt would aid the repair/discard decision. The proposal had a logical flow pattern that was well received by the group, however the deputy program manager rejected the proposal by saying, "We need answers, not more questions. Any

more detailed analysis will be too time consuming and our support money has to be obligated before the end of the fiscal year."

Joe Harris, the contractor APM-ILS, commented on the impact that any redirection from AR-10A support philosophy would have on the current ILS support effort. He reminded the group that AR-10A as amended for the A-13 aircraft was still the only contractual document by which the contractor was guided and all WRA and SRA MEA's were still being performed on that basis.

Commander Kirk evaluated his alternatives. If the AR-10A support philosophy was retained the requirement for local repair capability would be reduced. If the predicted MTBF's were accurate the avionics reliability would be quite high. However, the life cycle cost of procuring spares and keeping them in the pipeline could escalate if the predicted MTBF's were not achieved. AR-60, which was intended to provide more confidence, was now suspect due to some false assumptions and incorrect inputs as far as the Navy was concerned. The decision to repair the majority or the SRA's would require a substantial investment in additional automatic test equipment, more stocking of bits and pieces, additional maintenance engineering analysis on each SRA recoded as repairable, additional training, and other possible unknowns. On the other hand, the ability to repair SRA's at the local level should improve readiness and reduce the possibility of downed aircraft due to the lack of spare SRA's.

QUESTIONS

1. The APML is faced with the problem of acquiring support for the SRA's regardless of his decision to repair or discard. What are some factors he should consider in each case?

2. If you were the APML, what decision would you make regarding the SRA support plan?

3. Discuss the RILSD concept and the effect of its involvement in the A-13 program?

Pages 88 through 99 are not included in this copy of this thesis.
See note on page 11 for explanation.

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